CIVIL ENGINEERING

PERIODICALS
NOV 14 1955
MICHIGAN STATE

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CIVIL ENGINEERING

NOVEMBER 1955
VOL. 25 • NO. 11

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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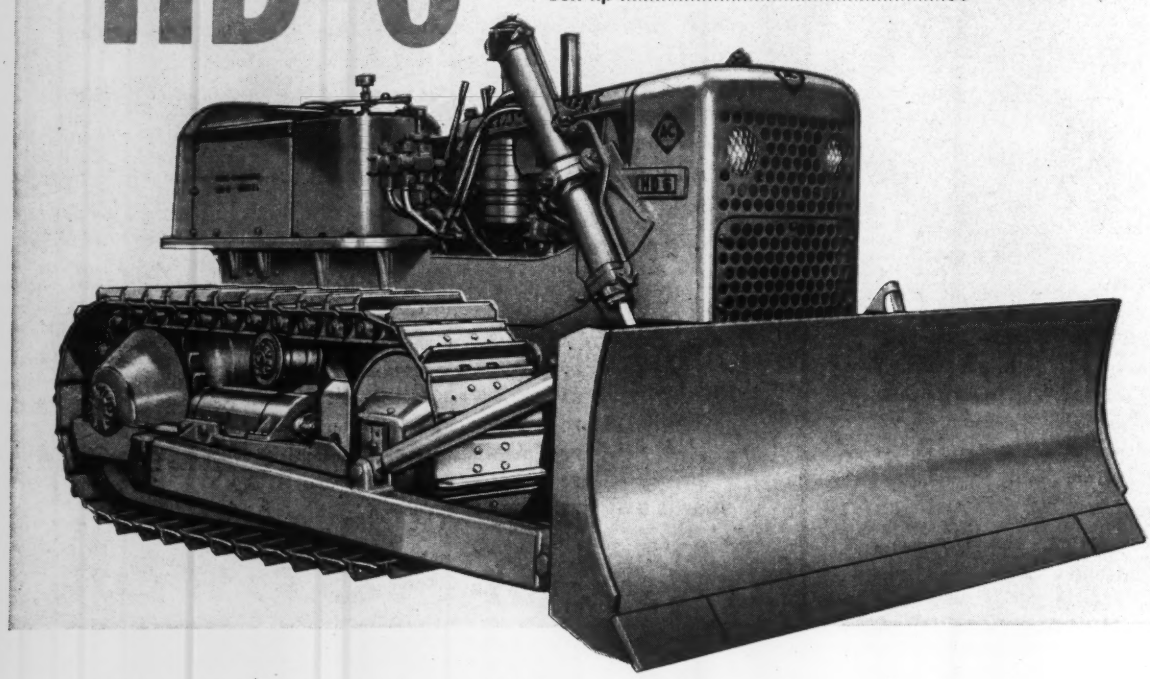

STEP UP PERFORMANCE, CUT JOB COSTS WITH EXCLUSIVE HD-6 FEATURES LIKE THESE...

- ★ Allis-Chalmers heavy-duty diesel engine — with "follow-through" combustion for long life, low upkeep.
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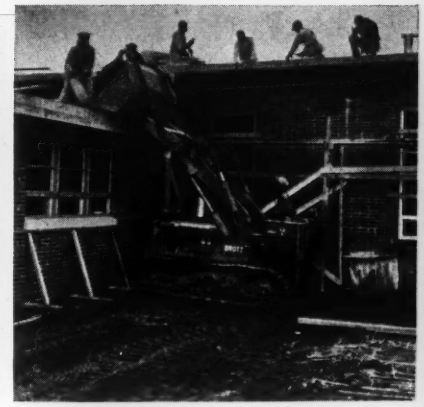
- ★ Tru-Dimension tracks — with new standards of strength and hardness *throughout* for extra wearability.
- ★ Unit construction — major assemblies like engine, clutches and final drives can be removed without disturbing adjacent parts.
- ★ Engine-mounted bulldozers — for top dirt-moving performance and extra tractor life.

80 ft ditch in 3 hours—Excavating for water main in Henderson, Texas, International "300" wheel tractor dug 100 cu yds of clay hourly. Backfilling was handled by rig's front-end loader. Ditch is 4 ft deep, 22 in. wide.



"We saved 100 man-hours by lifting zonolite roofing slabs with our International-Drott TD-6," reports M. G. Aldrich, Macon, Georgia, on the 13,000 sq ft building job shown. Lifts of 1 ton were made to 10 ft eave height.

Rugged in rugged rock—"TD-6 is ideal for opening underground mines," says Malcolm McDonald of Kiabob Uranium Corp, Green River, Utah, "It gets around fast in narrow tunnels, yet brings out big loads."

INTERNATIONAL HARVESTER

A machine size for every job . . . see your nearest INTERNATIONAL DISTRIBUTOR for details.

NEWS OF ENGINEERS

Herman G. Baity, professor and head of the department of sanitary engineering at the University of North Carolina, retired recently, and is now serving as director of the Division of Environmental Sanitation of the World Health Organization in Geneva, Switzerland. He has been with the university for 30 years, serving as head of the department of civil engineering school. **Daniel A. Okun,** on the engineering faculty since 1952, has been appointed the new professor and head of the department of sanitary engineering.

D. A. Firmage has resigned as assistant chief structural engineer for Patchen & Zimmerman Engineers, Augusta, to accept an appointment as associate professor of civil engineering at Brigham Young University, Provo, Utah.

Herbert Goodkind, formerly associated with D. B. Steinman, New York, has become connected with Goodkind and O'Dea consulting engineers with offices in Bloomfield, N.J., Hamden, Conn., and Malverne, N.Y.

Oliver H. Folsom has accepted a position with the International Cooperation Administration as river valley development adviser and is now stationed in New Delhi, India. Mr. Hazard had been the director for the project's services department of Peter Kiewit Sons' Co. in Portsmouth, Ohio.

Marquand S. Gorton, of Bellevue, Wash., has been appointed vice-president and manager of the Puget Sound Bridge & Dredging Company. Mr. Gorton has been employed with the company for eleven years and formerly was chief engineer.

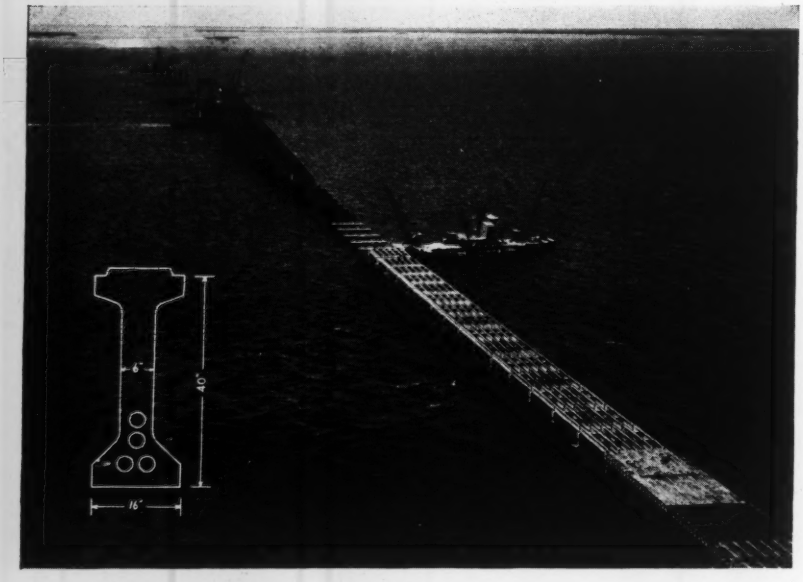
Thomas Gordon Harton, Lieutenant Colonel, U. S. Army, has been appointed assistant district engineer of the Vicksburg District of the Corps of Engineers. Colonel Harton recently arrived from Pusan, Korea, where he was post engineer at the Pusan Military Post.

Robert Aaron Hechtman, specialist in structural design and former professor of structural research at the University of Washington, Seattle, has been appointed professor of civil engineering at George Washington University's School of Engineering, in Washington, D.C. Professor Hechtman will also serve as executive officer of the civil engineering department.

Four ASCE Members were among seventeen engineers and civic leaders given honorary degrees by Brooklyn Polytechnic Institute in recent ceremonies ending its centennial year. They are: **Ernest Payson Goodrich,** engineering consultant and member of the Polytechnic Corporation for thirty-six years; **Ole Singstad,** civil engineer and noted designer and builder of tunnels; **Philip Sporn,** engineer and industrialist and president of the American Gas and Electric Co; and **Ernest Van Norden,** retired engineer for Consolidated Edison, banking executive, and member of the Polytechnic Corporation for thirty-five years. Mr. Goodrich's degree was awarded posthumously the day after his death (obituary on page 104.)

Gerard A. Rolich, professor of civil engineering at the University of Wisconsin, has been awarded the 1955 Harrison P. Eddy Medal for outstanding research in the field of sewage waste treatment.

Harmer A. Weeden, until recently on the Bucknell University engineering staff, is now associate professor of civil engineering at Pennsylvania State University, University Park. In the September issue it was incorrectly stated that Professor Weeden had joined the University of Pennsylvania staff.



Why They Used Plastiment in Florida's Sunshine Skyway

With a saving of $140,000 riding on the use of prestressed construction in this bridge over Tampa Bay, the engineers specified three principal concrete requirements for the 2178 post-tensioned girders involved: *Concrete compressive strength before tensioning steel — 4000 psi; Minimum compressive strength at 28 days — 5000 psi; and concrete had to be workable enough to permit uniform placement through the narrow section of each girder (see sketch).*
Plastiment Concrete Densifier's properties suited all 3 requirements. Plastiment's retarding action allowed more time for uniform depositing and compaction through the thin girder sections. And because, after final set, Plastiment-concrete consistently gains strength faster than ordinary concrete, Plastiment produced the desired post-tensioning strength at 3 to 5 days; with strengths as high as 7400 psi at 28 days.
For complete details on how Plastiment operates to produce uniformly high-quality concrete, send today for a copy of the illustrated booklet, "Plastiment Concrete Densifier." Our engineers will be glad to tell you how Plastiment can help you on your present job.

Owner: State Road Dept. of Florida, Tallahassee
Consulting Engineers: Parsons, Brinckerhoff, Hall & Macdonald, New York City
Concrete Contractor: Hardaway Contracting Co., Columbus, Ga.

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Emmett H. Karrer, of the Ohio State University civil engineering faculty, was in Rome in October, where he appeared on the program of the World Highway Meeting. Professor Karrer is general chairman of the Ohio Highway Engineering Conference.

Mark D. Hollis, assistant surgeon general and chief engineer of the Public Health Service, left Washington on October 5 to inspect U.S. Operations Missions in Southeast Asia and the Middle East. He will discuss sanitary engineering and environmental sanitation programs with the Mission chiefs and chief sanitary engineers in these countries.

Samuel B. Morris, a Director of ASCE, has retired as general manager and chief engineer of the Los Angeles Department of Water and Power after eleven years in this important post. More than 1,000 Los Angeles citizens and civic officials attended a Civic Luncheon and Recognition Program in his honor on September 28. The many tributes to Mr. Morris from national, state, and local leaders included a message from former President Hoover, who hailed him as "a great citizen and a great engineer." Mr. Morris will continue to perform special services for the Department in connection with atomic power developments and plans for future water supply sources. At the end of November he will go to Israel as member of a three-man board of United States consultants on the Israeli water supply.

Samuel B. Morris

William G. Armstrong, director and member of the executive committee of the Arundel Co., Baltimore, Md., has been elected senior vice-president. Mr. Armstrong began with Arundel in 1928 and has been vice-president in charge of dredging since 1943. **Richard Stephens,** administrative assistant for the same company, has been elected vice-president-construction.

Edward Albert Mueller has taken over new duties as an assistant engineer of traffic with the Florida State Road Department. Previously, Mr. Mueller was a research assistant for the Yale University Bureau of Highway Traffic.

(*Continued on page 24*)

SIMPLEX gauges and controllers maintain peak filter efficiency

Gaines Construction Company plans to build Carol City's 10,000 homes in less than three years . . . the largest housing development in Florida's history. The houses are priced at builder's cost. Sponsors plan to make their profits on development of the land, and ownership of the commercial properties and the $4,000,000 water and sewage utilities.

Water and sewage rates are low. So to earn a profit, this utilities plant had to be of ultra-modern design for highest operating efficiency. That's why the Miami Springs engineering firm of Clifford & Associates chose Simplex Filter Gauges and Controllers.

Supt. Tims reports: "Our Simplex equipment is quickly paying for itself by giving us maximum filter efficiency. The Simplex Gauges measure rate of flow and loss of head with the highest accuracy. The Simplex Controllers respond instantly . . . automatically keep flow steady at the set rate."

William C. Tims, Supt. Carol City Utilities, Inc., inspects control deck of the water treatment plant.

WRITE for Technical Bulletins today!
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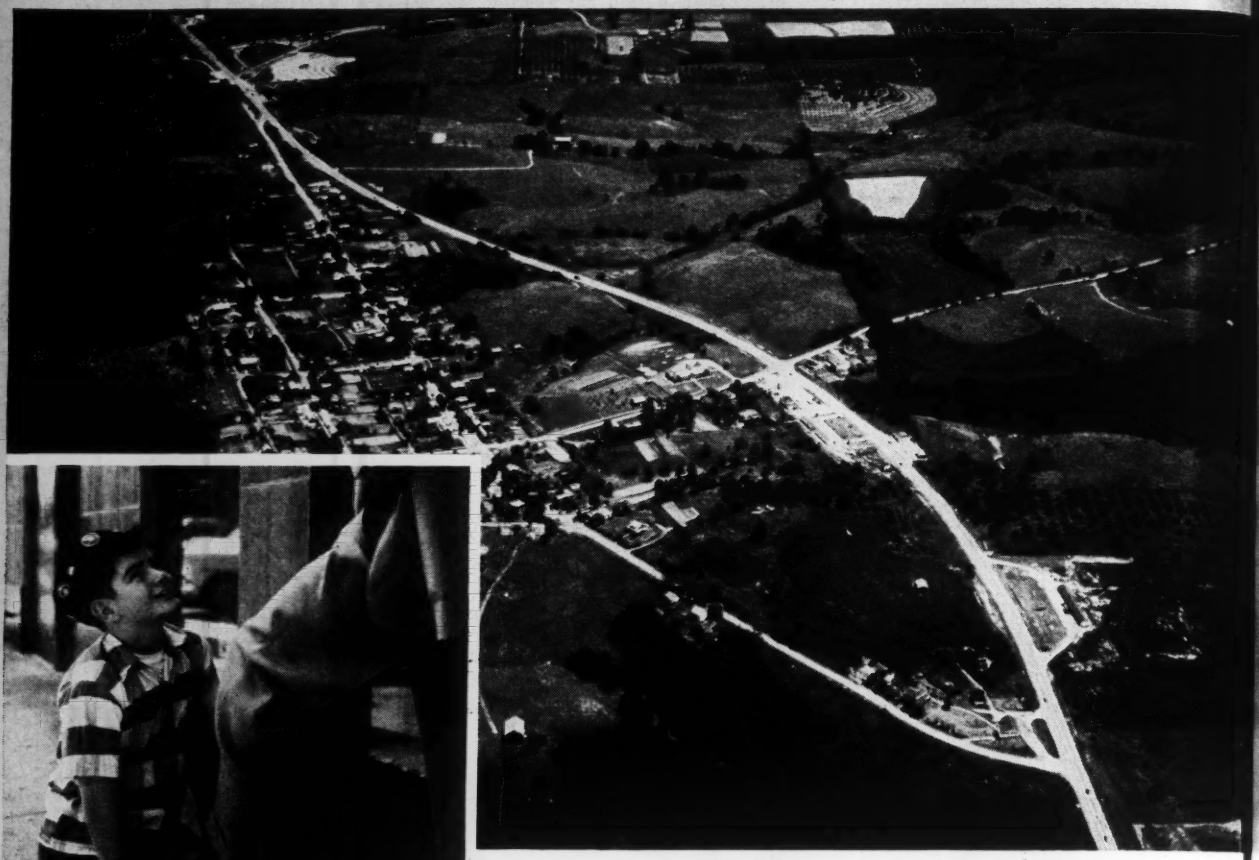

"Boy, that new highway sure helped us businessmen!"

Here's what happened in one Ohio town as part of that state's expanding highway program. Know how your own state is handling its traffic problem?

Ted's only ten but he's got a good head for business. So when he heard all the talk about taking the state highway off Main Street and running it out around his Ohio hometown, he paid attention. The barber argued a bypass would hurt business. Mr. Keyser at the hardware store was worried, too. Ted wondered if it was such a good idea at that.

Then the bypass was finished, and what happened? Fast-moving through traffic let the town alone and local trade found a place to park once more. Main Street relaxed: it became possible again to get a leisurely haircut, pick up those wood screws and window screen . . . and stop for a shine. And business picked up. In a town like Ted's, for example, merchants say business went up some 12% to 20% after their bypass was finished.

Bypassing villages is only one phase of Ohio's highway program. 4000 miles of road have been built or improved in the past five years. A new 326-million-dollar turnpike now links the Pennsylvania and Indiana lines. 150 to 200 million dollars will be spent each year for the next five years. That will not solve all the problems, but the traffic picture in Ohio gets brighter all the time.

Your own state has a sensible road program, too. Write your Highway Commissioner or Governor and find out what it is, if you don't already know. Study it. Then, as an informed citizen, let your feelings about it be known.

After all, it affects you as much as it does Ted. Maybe more.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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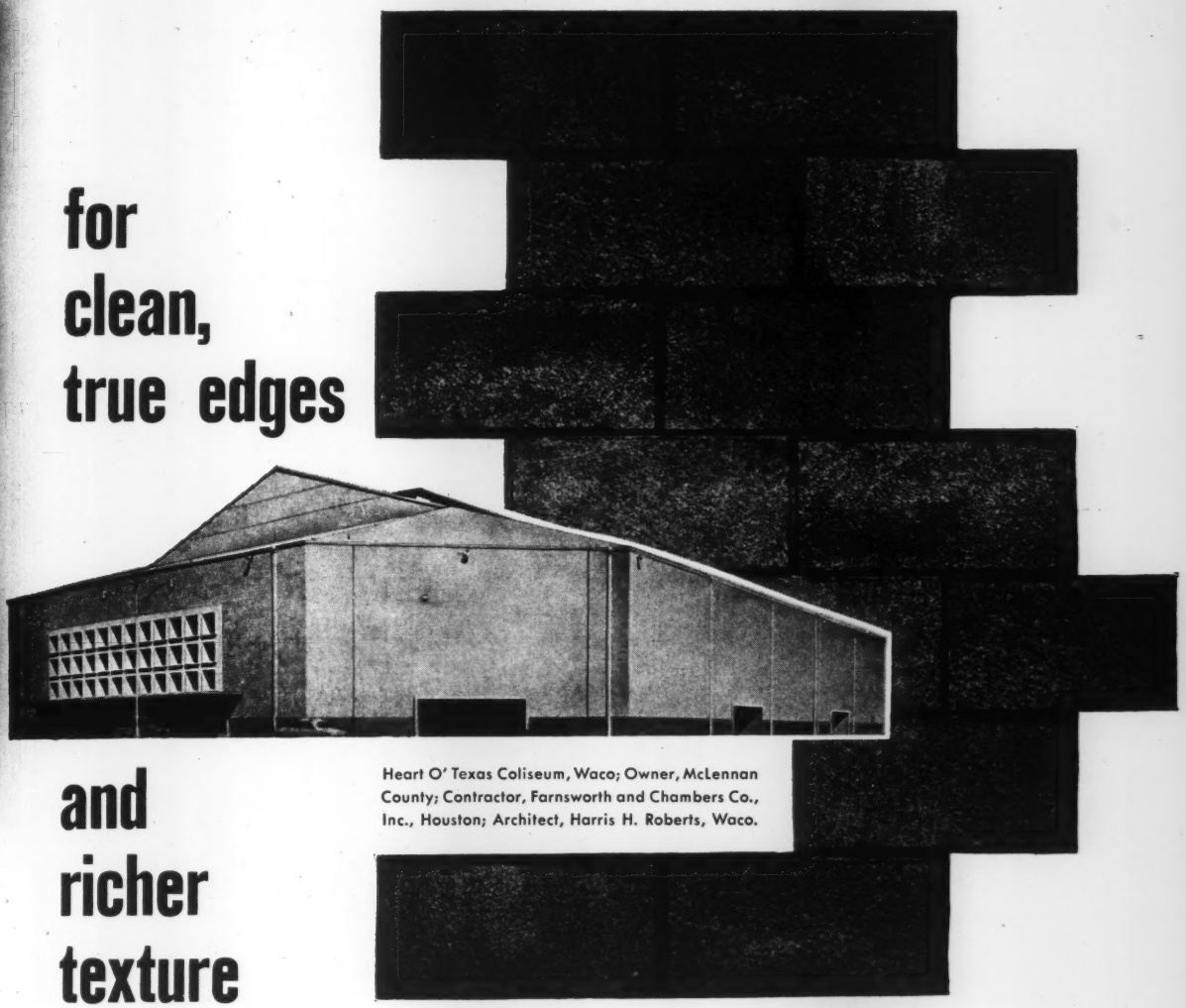
THE WORLD'S NO. 1
ROAD BUILDING EQUIPMENT

Wherever you see Caterpillar machines working on your roads, you can be sure your state is getting its money's worth.

for clean, true edges



Heart O' Texas Coliseum, Waco; Owner, McLennan County; Contractor, Farnsworth and Chambers Co., Inc., Houston; Architect, Harris H. Roberts, Waco.

and richer texture

...concrete block made with DURAPLASTIC*

Over ninety-eight thousand concrete blocks went into the building of Waco's Heart O' Texas Coliseum. The job was a big one, calling for good looks on a large scale. That's why concrete block made with Atlas Duraplastic air-entraining portland cement were used.

A good choice, too. Because Duraplastic makes a more compact, more cleanly formed block with greater resistance to the passage of water. For outstanding durability and good appearance, use Duraplastic-made block on your next project.

Use Atlas Duraplastic cement in your regular concrete work, too. Aids proper placement and increases durability. Requires no unusual changes in procedure. Sells for the same price as regular cement. Complies with ASTM and Federal Specifications. Write for free descriptive booklet.

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UNITED STATES STEEL CORPORATION SUBSIDIARY

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* "Duraplastic" is the registered trade-mark of the air-entraining portland cement manufactured by Universal Atlas Cement Company.

CEN-D-177

AIR-ENTRAINING PORTLAND

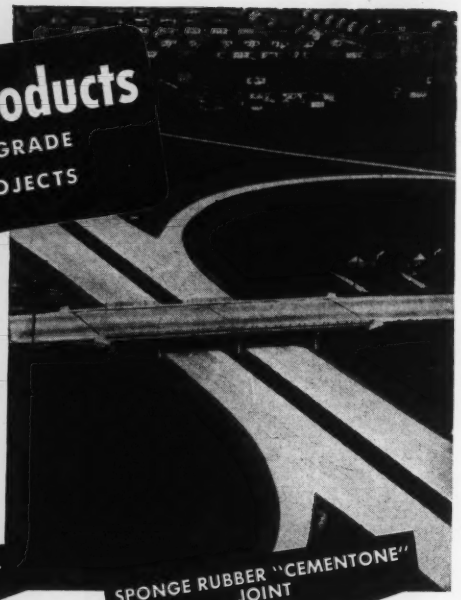
Atlas® Duraplastic Cement

MAKES BETTER CONCRETE AT NO EXTRA COST

UNITED STATES STEEL HOUR—Televised alternate Wednesdays—See your newspaper for time and station.

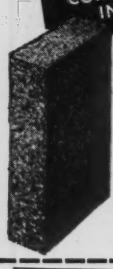
Servicised Products

for BRIDGE and GRADE SEPARATION PROJECTS



Concrete bridge and grade separation structures are subject to unusual amounts of movement due to temperature change, traffic stresses, and settling simply because they have to be built "up in the air." The following are a few of the Servicised Products which you can specify or use which will take this movement and yet keep your job sealed against moisture and attractive in appearance.

CORK and SELF-EXPANDING CORK JOINT FILLERS



Both types are non-extruding resilient and compressible, inconspicuous in color. Cork recovers 95% original thickness after compression; Self-Expanding Cork is treated to expand 50% beyond original thickness to keep joint filled regardless of contraction movement.

SPONGE RUBBER "CEMENTONE" JOINT FILLER

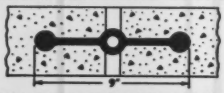
Fully resilient high quality blown sponge rubber "Cementone" blends with color of concrete. Uniform thickness and density. Available in varying degrees of compressibility to meet your requirements.

MOLDED PARA-PLASTIC

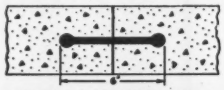
For sealing keyed construction or contraction joints in vertical walls. Maintains bond with concrete at temperatures down to sub-zero. Simple installation insures a resilient, moisture-tight seal of the joint.

PARA-LATERAL STRIP

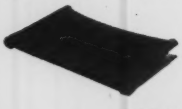
For sealing backfilled vertical construction or expansion joints in retaining walls, abutments, wing walls, foundations, tunnels, etc. against seepage to exposed side. Para-Plastic facing of strip insures permanent adhesion to concrete.



HOLLOW BULB RUBBER WATERSTOP
For permanent, watertight seals in expansion joints where a high degree of expansion and contraction is expected.



FLAT DUMBBELL TYPE
Flexible, elastic rubber with very high tensile strength for sealing construction joints.



SPLIT DUMBELL TYPE
Faster to install . . . eliminates split forms (1) Nail to bulkhead in form of a "T" (2) Section is poured and bulkhead stripped. (3) Divided section is joined together by stapling or with rubber cement.

ASPHALT PLANK
Servicised Mineral Surfaced or Standard Plank is resilient, quiet, long-wearing. Widely used on bridges, underpasses and grade separations as a wearing surface or as a waterproofing protection course.

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6051 WEST 65th STREET • CHICAGO 38, ILLINOIS

News of Engineers

(*Continued from page 19*)

Fred S. Childs, of Bogert and Childs, New York consulting engineers, has been elected president of the New Jersey State Board of Professional Engineers and Land Surveyors. Mr. Childs is now serving his sixteenth year as a member of the State Board and his third term as president.

Frank W. Herring, Port Washington, N.Y., has been appointed to the Port of New York Authority's newly established position of deputy director for comprehensive planning. Mr. Herring, who has been chief of the Authority Planning Division for the past eight years, will assist Roger H. Gilman, director of port development.

Frank W. Herring

Earl Louis Mosely, until recently manager and secretary of the Denver Water Department, has been appointed project engineer. Mr. Wadsworth has been active in the San Franciso Section, which he served as president.

Alton D. Taylor, professor and head of the civil engineering department of Ohio Northern University, has been made assistant dean of the College of Engineering.

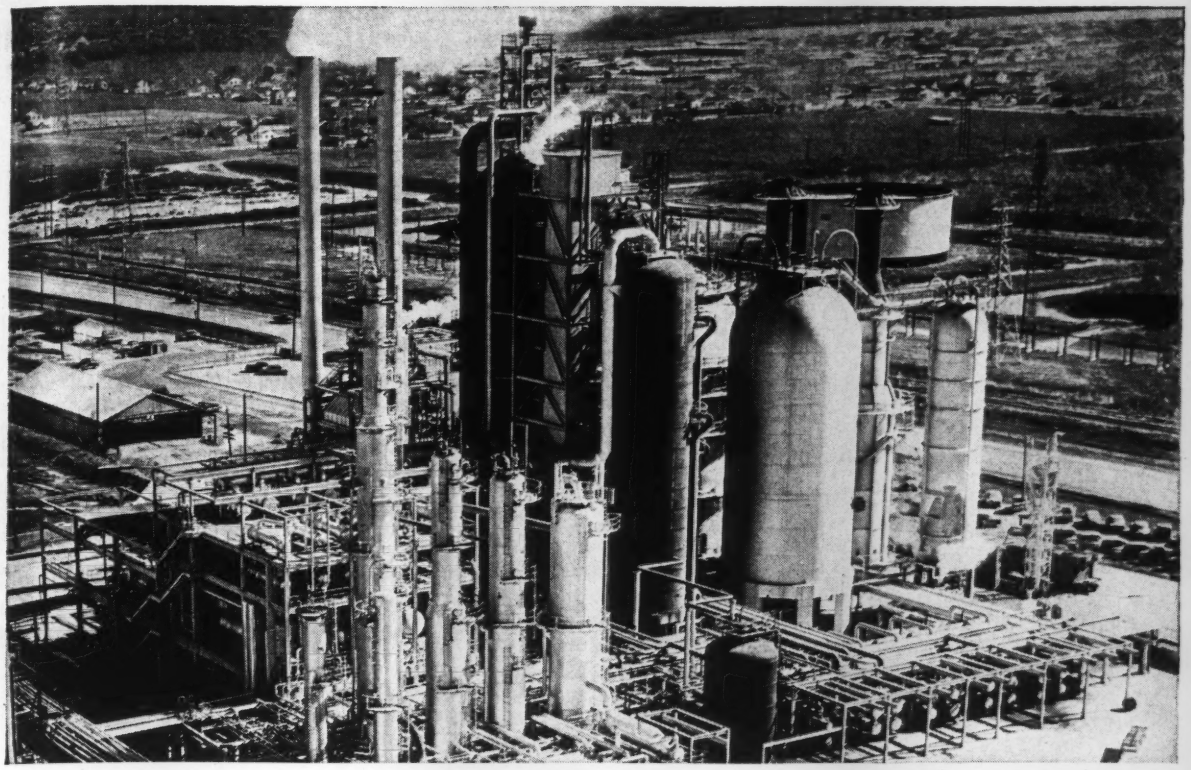
Eugene Francis Gibbons has been appointed chief engineer of the New York State Department of Public Works, Albany. At the time of his appointment Mr. Gibbons was chief engineer for J. Rich Steers, Inc., New York contractors on naval base expansion in French Morocco. Most of his nineteen years in the construction field have been spent in the New York area.

Eugene F. Gibbons

John J. Benoit, chief concrete inspector for H.A. & J.A. Sewell on construction of the Box Canyon Dam, Newport, Wash., has become connected with the Harza Engineering Co. in Chicago. **Robert W. Kjosness,** who has also been working on the recently completed project, has taken a position with Howard, Needles Tammen & Bergendoff to work on turnpike construction in the Kansas City area.

James Bernard McDonald, assistant professor of civil engineering at the University of Pittsburgh has been promoted to associate professor.

(*Continued on page 28*)



SINCLAIR'S NEWEST "CAT"

RESTS ON Raymond PILES

OVER 21,000 FEET of Raymond Step-Taper Piles support Sinclair Refining Company's new 50,000-barrels-per-day Fluid Catalytic Cracking Unit in Houston. What's more, Raymond drove the piles for this giant "Cat Cracker" in just 37 working days. For over a half century, we've been providing this type of service . . . just one of the many reasons why, year after year, our client list continues to grow. May we be of service to you, too?

RAYMOND'S DOMESTIC ACTIVITIES
Foundations . . . Marine structures and Off-shore Construction . . . Heavy Construction . . . Soil Investigations.

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Complete service for all types of construction.

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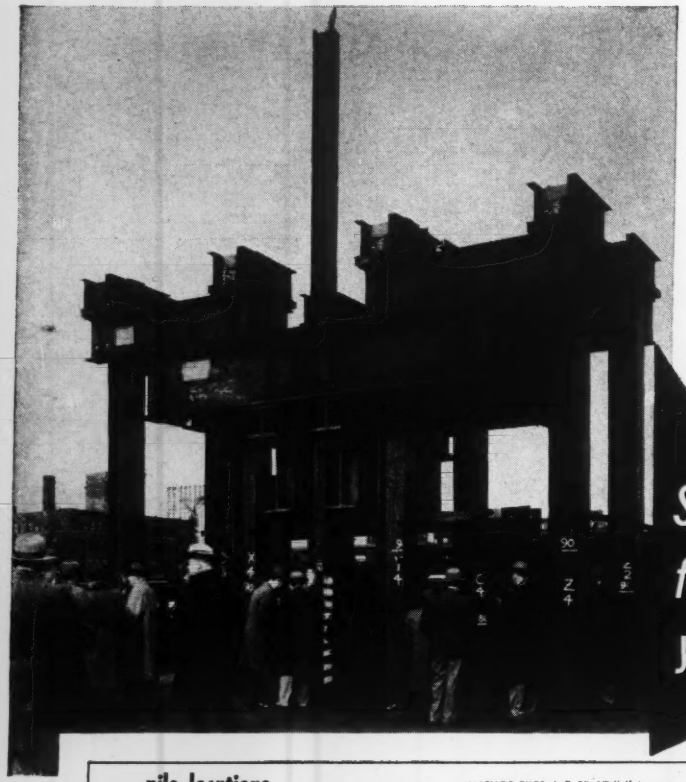
Chicago tests prove USS Steel



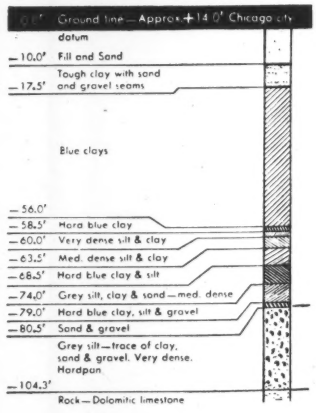
See for yourself

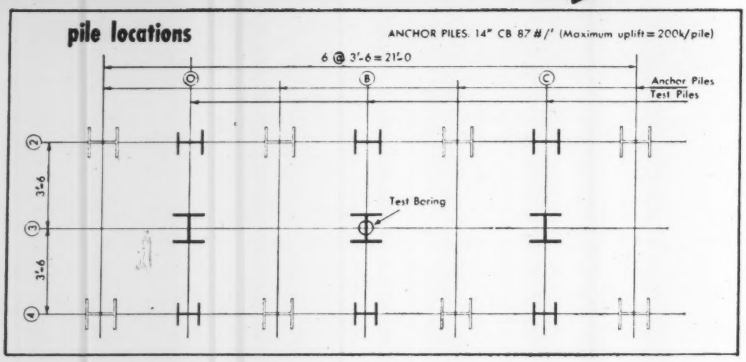
To provide authentic data showing USS steel H-beam piles capable of meeting limits allowed by the City of Chicago Building Code, United States Steel Corporation had the Armour Research Foundation of Illinois Institute of Technology conduct tests on a site having soil conditions typical of the Loop area. Tests were made at the corner of Harrison and Halstead Streets. A total of 17 piles were driven, eight of which were used as anchor piles. Data on the nine test piles is shown in the table below.

USS Steel H-Beam Bearing Pile Test

Pile Number								
Pile Size								
End Conditions								
Proposed Allowable Load—Tons								
Test Load—Tons								
No. of Blows in Last Inch								
Estimated Design Load by ENR Formula‡								
Total Deflection at Proposed Allowable Load								
Total Deflection at Test Load								
Rebound from Test Load								
Total Net Settlement								
Allowable Total Net Settlement by Chicago Code								
Load at Failure—Tons								
Avg. Unit Stress (fs) at Failure—psi								
Total Deflection at Failure								
Rebound from Failure Load								
Net Settlement after Removal of Failure Load								
Manner of Failure								

*Final driving of all piles by Vulcan type OR hammer—30,225 ft. lbs. ‡ENGINEERING NEWS formula.


0.0' Ground line—Approx. +14.0' Chicago city datum
—10.0' Fill and Sand
Tough clay with sand and gravel seams
—17.5'
Blue clays
—56.0'
—58.5' Hard blue clay
—60.0' Very dense silt & clay
—63.5' Med. dense silt & clay
—68.5' Hard blue clay & silt
—74.0' Grey silt, clay & sand—med. dense
—79.0' Hard blue clay, silt & gravel
—80.5' Sand & gravel
Grey silt—trace of clay, sand & gravel. Very dense. Hardpan
—104.3'
Rock—Dolomitic limestone



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The design possibilities, low cost, and ease of installation of USS steel H-Beam bearing piles offer definite advantages over foundation caissons for supporting heavy buildings. Buildings of any height can be founded on steel H-Beam piles without limitations resulting from insufficient penetration. Excessive amounts of free water, marsh gas, and other adverse conditions which sometimes halt construction of open-pit caissons, offer no obstacles to obtaining required design loads with steel H-beam bearing piles. Furthermore, the cost in time, materials, and equipment needed to construct open-pit caissons makes USS steel H-Beam Bearing Piles the most economical type of foundation you can use.

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high load-carrying capacity of H-Beam Bearing Piles

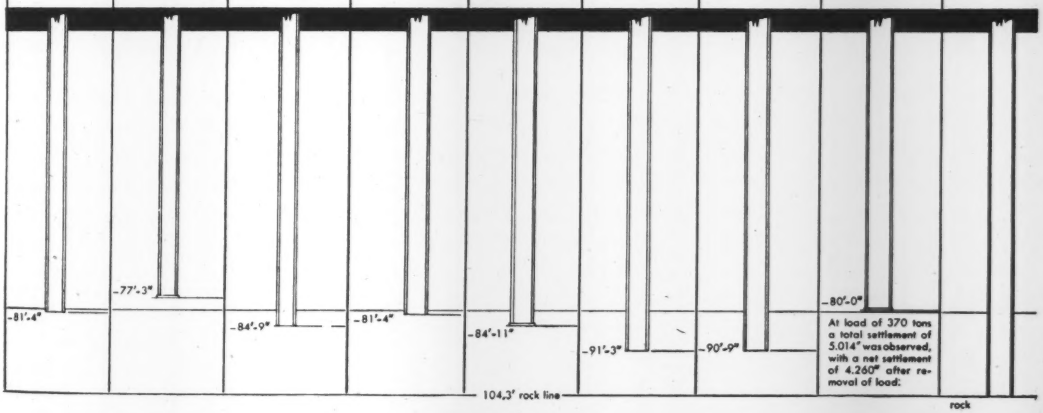
All of the nine piles tested exceeded the requirements of the Chicago Building Code, except for the closed end, 14-inch H-beam bearing pile that failed by excessive net settlement at a load of 370 tons. This pile was not driven to hardpan inasmuch as the desired driving resistance was attained before hardpan was reached. Therefore, it seems logical to assume that for loads of the magnitude of those under discussion, firm seating in hard soil should be a requirement.

Here again is proof that USS Steel H-Beam Bearing Piles are capable of carrying heavy foundation loads into stable mediums lying at great depth. Their capacity for high unit loads, both vertical and horizontal, permits fewer piles and fewer driving operations for a given load. They are readily handled in the field by ordinary equipment, are easy to splice, eliminate jetting, and withstand rough handling.

If you would like to receive detailed information regarding your particular foundation problems, please contact the office nearest you.

Data* (In accordance with Chicago Code requirements—in addition B4, B2 and B3 were tested to failure.)

04	C4	B4	02	C2	B2	03	C3	B3
10" CBP 42#/'	10" CBP 42#/'	10" CBP 42#/'	12" CBP 53#/'	12" CBP 53#/'	12" CBP 53#/'	14" CBP 117#/'	14" CBP 117#/'	14" CBP 117#/'
Open	Closed	Open	Open	Closed	Open	Open	Closed	Open
75	75	75	100	100	100	200	200	200
150	150	150	200	200	200	400	400	400
10	10	31	7	7	Refusal	22	24	On Rock
151	151	228	124	124	.....	208	213	.....
0.317"	0.312"	0.168"	0.359"	0.338"	0.270"	0.378"	0.454"	0.293"
0.773"	0.976"	0.501"	2.147"	1.321"	0.637"	0.891"	See Below	0.695"
0.633"	0.730"	0.549"	0.754"	0.810"	0.670"	0.723"		0.657"
0.140"	0.246"	—0.048"	1.393"	0.511"	—0.033"	0.168"		0.038"
1.50"	1.50"	1.50"	2.00"	2.00"	2.00"	4.00"	4.00"	4.00"
		240 34400 psi 0.985" 0.831" 0.154" Local Flange Buckling Above Ground			300 38500 psi 1.079" 0.932" 0.147" Local Flange Buckling Above Ground			635 36900 psi 2.669" 1.176" 1.493" Yielding Over Cross Section of Pile



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USS

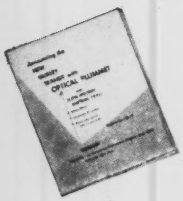
UNITED STATES STEEL

New Optical Plummet Built into Gurley Transit Saves Set-up Time, Improves Accuracy on Windy Days

Instrument Available in Two Models with Shifting Heads

Years ago, Gurley introduced lightweight instruments to combat wind vibrations. Now Gurley further beats the wind problem with an optical plummet *built into* the instrument.

The new Gurley Optical Plummet Transit eliminates swing and sway of the cord and plumb—always time-consuming and exasperating on a windy location, and inaccurate as well. Positive accuracy of set-up is assured with the Gurley Optical Plummet.



Two types of shifting head are available: one, which uses the Gurley wide-frame tripod, is adjusted over the point—using a method similar to the theodolite...the other, featuring a slow-motion, two-direction cross-feed head, permits movement in two directions at right angles to each other without disturbing the level of the plate.

Gurley's new Optical Plummet Transit offers one of the advantages of the optical-reading theodolite *plus* the desirable features of simplicity and universal acceptance of the American transit. For further details, write for Bulletin OP-57.

GURLEY

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News of Engineers

(*Continued from page 24*)

Jack H. McMinn, recently opened an office called Soil Testing Services of California, Inc., at 1798 Filbert Street, San Francisco. He was previously a salesman with Western Pine Supply Co., Emeryville, Calif.

Walter H. Zimpfer, of the civil engineering staff of the University of Florida, has been granted a one-year leave of absence to serve as assistant in the University Relations Division of the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn. Mr. Zimpfer has been assistant professor and assistant research professor at the University of Florida since 1950.

Walter H. Zimpfer

Werner H. Grune, now professor of civil engineering at Georgia Institute of Technology, has returned from Europe after a year's leave of absence working for the Corps of Engineers in France and the U.S. Air Force in Germany. Now Dr. Grune has resumed his teaching duties and started work on a $15,000 research project, granted by the National Science Foundation, on the "Treatment and Disposal of Radioactive Sludges."

Bernard D. Murphy has recently joined the Department of Forests and Waters of the Commonwealth of Pennsylvania as chief of the flood control division. Mr. Murphy has just completed an assignment as chief design engineer of the Irrigation, and Flood Control Division, Iraqi Ministry of Development, Baghdad, Iraq.

Bernard Murphy

Robert A. W. Carleton, construction engineer and former president of the Hudson and Manhattan Railway, has been elected chairman of the newly-formed engineering council of Columbia University, which will help guide the policies and expansion program of the School of Engineering.

Keith M. Saville has just been named field engineer for the Calcium Chloride Institute. He will make his headquarters in Washington. Mr. Saville was formerly materials engineer for the District of Columbia Department of Highways.

Charles G. Dandrow has been appointed to the newly-created post of vice-president for Customer Relations for the Johns-Manville Co. Mr. Dandrow, who has been general sales manager of the company's Industrial Products Division, continues as vice-president of Johns-Manville Sales Corporation.

Maurice L. Dickinson, chief hydraulic engineer for Bechtel Corp., Los Angeles, has been elected president of the Engineers Club of Los Angeles.

John P. Riley, newly elected director of ASCE and past-president of the Metropolitan Section, has been appointed vice-president and chief engineer of the Ibec Housing Corporation, New York. Mr. Riley will continue in his present capacity as director of development for the New York Housing Authority until January 1, when he will assume his new position.

Roy T. Sessums, former dean of engineering at Louisiana Polytechnic Institute, has joined Freeport Sulphur Co., Shreveport. For the past three years Mr. Sessums has been director of the Louisiana State Department of Public Works and the present president of the Louisiana Section.

Harry S. Rogers, president of the Polytechnic Institute of Brooklyn, received the Annual Award for meritorious service of New York Chapter of the New York State Society of Professional Engineers at the organization's annual dinner on September 28. Dr. Rogers was honored for his "outstanding services in the field of engineering education and for his accomplishments in furthering the engineering profession."

James P. McKean has joined the American Appraisal Co., with headquarters in Milwaukee. Prior to his new connection he was professor in the general engineering department and in the Graduate College of Iowa State College, where much of his time was devoted to the theory and practice of valuation.

Fred Bartlett, president of Lockwood, Kessler & Barlett, Inc., Engineers and Surveyors, announce that the firm is moving into new quarters at Syosset, N.Y., on November 1. The new building, with 25,000 sq ft floor area, will house functions now carried on at three locations in Great Neck and Manhasset.

Haaren Miklofsky has joined the civil engineering faculty of Rensselaer Polytechnic Institute as a visiting associate professor of structural engineering. He has held a similar post at George Washington University for the past six years.

Non-ASCE Meetings

American Institute of Chemical Engineers. Forty-eighth annual meeting at the Hotel Statler, Detroit, November 27–30.

American Public Health Association. Eighty-third annual meeting at the Municipal Auditorium, Kansas City, Mo., November 14–18. Further information from APHA, 1790 Broadway, N. Y.

American Society of Mechanical Engineers. Diamond Jubilee 75th Anniversary Annual Meeting at the Congress, Conrad Hilton, and Blackstone Hotels, Chicago, the week of November 13. Details from ASME, 29 West 39th St., New York, N.Y.

Building Research Institute. Plastics study group will hold its first meeting November 14–15, at the University of Michigan. Further information from BRI, 2101 Constitution Ave., Washington 25, D.C.

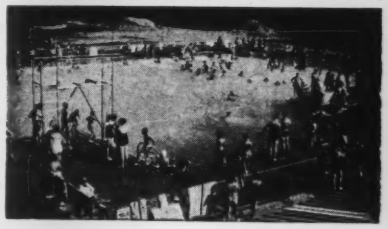
Chicago Exposition of Power and Mechanical Engineering. Under the auspices of the ASME, at the Chicago Coliseum, November 14–18. Details from CEPME, 480 Lexington Ave., New York 17, N.Y.

Chi Epsilon. Joint meeting of graduates and undergraduates on December 7 at 7 p.m., in Engineering Societies Building, 33 West 39th St., New York, N.Y. A dinner in the New York Times Dining Room at 6 p.m. will precede the meeting.

Engineer Joint Council. Nuclear Engineering and Science Congress and Atomic Exposition (sponsored by the American Institute of Chemical Engineers) in Cleveland, Ohio, December 12–16. Information from EJC, 29 West 29th St., New York 18, N.Y.

Society for Experimental Stress Analysis. Annual meeting at the Hotel Sheraton, Chicago, November 16–18. Information from W. M. Murray, Secretary-Treasurer, SESA, P.O. Box 168, Cambridge 39.

Everything you need for SWIMMING POOLS



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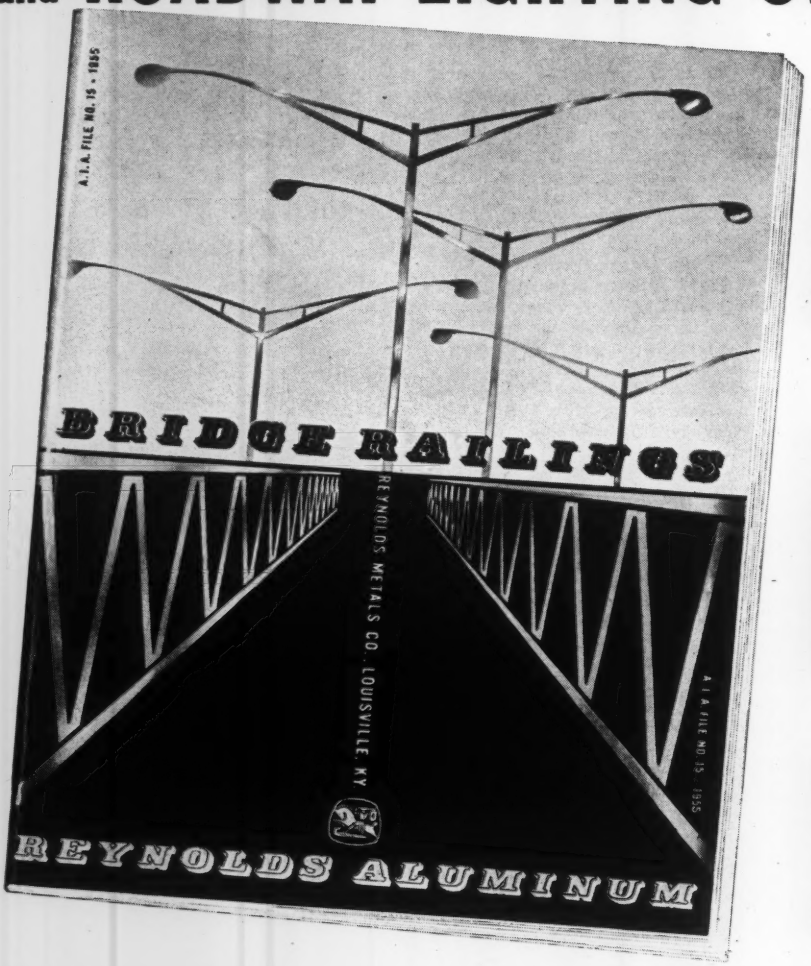
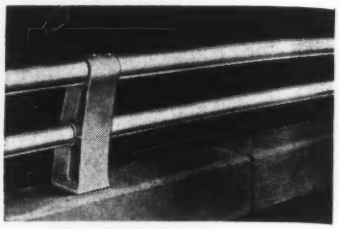
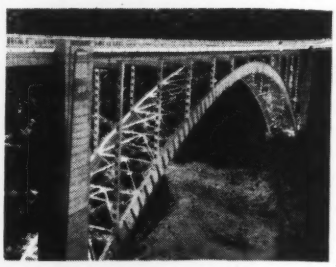




Reynolds Aluminum Guard Rails on Paseo Trafficway between North Kansas City and Kansas City, Missouri.



Reynolds Aluminum Railings on Pinto Creek Bridge, Globe, Arizona

Reynolds Aluminum Railings, Light Standards and Electrical Conduit Racks on Bay St. Louis Bridge, Miss.

The rapidly increasing preference for low-cost, low-maintenance aluminum in bridge railings makes an up-to-date technical handbook highly desirable. Reynolds new 52-page file size book includes architectural and design criteria, specifications, detailed analyses of typical installations, complete descriptions of available components, surface treatment and insulation. An appendix covers deflection impact, cost studies and the new alloy designation system. For advice on special aluminum requirements, for names of nearest fabricators and for distributors of standard Reynolds mill products, call the nearest Reynolds Sales Office listed under "Aluminum" in classified directories.

For your copy of "Aluminum Bridge Railings," please write on your letterhead to: Architect Service, Reynolds Metals Company, Louisville 1, Ky.

For quick reference, see catalog $\frac{5a}{Re}$ in Sweet's Architectural File.

REYNOLDS ALUMINUM

See "FRONTIER," Reynolds new dramatic series, Sundays, NBC-TV Network.

do you know that

The "Seven Engineering Wonders" have been selected and announced? In the lead article James K. Finch, Columbia University's retired dean emeritus of engineering and an authority on engineering history, discusses the modern "Seven Wonders"—selected by an ASCE committee after careful study of the Sections' choices. The "wonders" are also the subject of an extensive *Readers Digest* article (November issue).

Our motor vehicle registration has more than doubled in the past ten years? In 1946 there were 30,000,000 registered motor vehicles in the United States, and today there are 61,300,000. Highways, however, remain of 1942 vintage. These are some of the sobering facts brought out by the Society's new President, Enoch R. Needles, in his inaugural address, which will be published in the December issue.

Sunlight has been used to power a telephone call? One more scientific miracle came off without fanfare in Georgia early in October when engineers threw a switch to shift a rural circuit from usual battery power to operation on electricity made from solar energy. The fact that the sky was overcast did not affect the success of the experiment, which was made possible by the newly developed solar battery.

Sanitary engineers are generally happy in their choice of a career, but more than a third of them are dissatisfied with their salaries? These and other facts obtained from the "Earnings and Satisfaction Survey," conducted by the Sanitary Engineering Division in March, are discussed in Proceedings Paper 773, which is available from Society Headquarters.

A new fast-climbing weather balloon has been developed? An "Express Balloon" that climbs at an average speed of 1,800 fpm has been developed by the Army Signal Corps Engineering Laboratories at Fort Monmouth, N.J. The new device makes it possible to collect weather data miles aloft almost twice as fast as formerly.

In the next decade the United States will pour some $600 billion into construction and building materials? This prediction was made at the fall meeting of the Producers' Council by George Cline Smith, economist for the F. W. Dodge Corp. Dr. Smith also foresees some 12,000,000 to 13,000,000 new housing units being built in the same period. This forecast, he says, is conservative and does not anticipate any construction boom.

Engineering graduates from state-supported colleges are getting increased professional recognition? Reporting a study of college graduates listed in the 1954 *Who's Who in Engineering*, Charles J. Baer writes in the October issue of *Mechanical Engineering* that the names of 930 M.I.T. engineering alumni appear in the book. Next come Michigan with 620, Cornell with 582, Purdue with 568, Illinois with 496, Wisconsin with 350, California with 334, Ohio State with 321, and Kansas with 301.

The United States is going to build a space satellite? Production of the man-made satellite will get under way soon, following the award of a Department of Defense initial contract (for $2,035,033) to the Glenn L. Martin Co., of Baltimore. The United States will launch the satellite in outer space in 1957 or 1958 for research in connection with the International Geophysical Year.

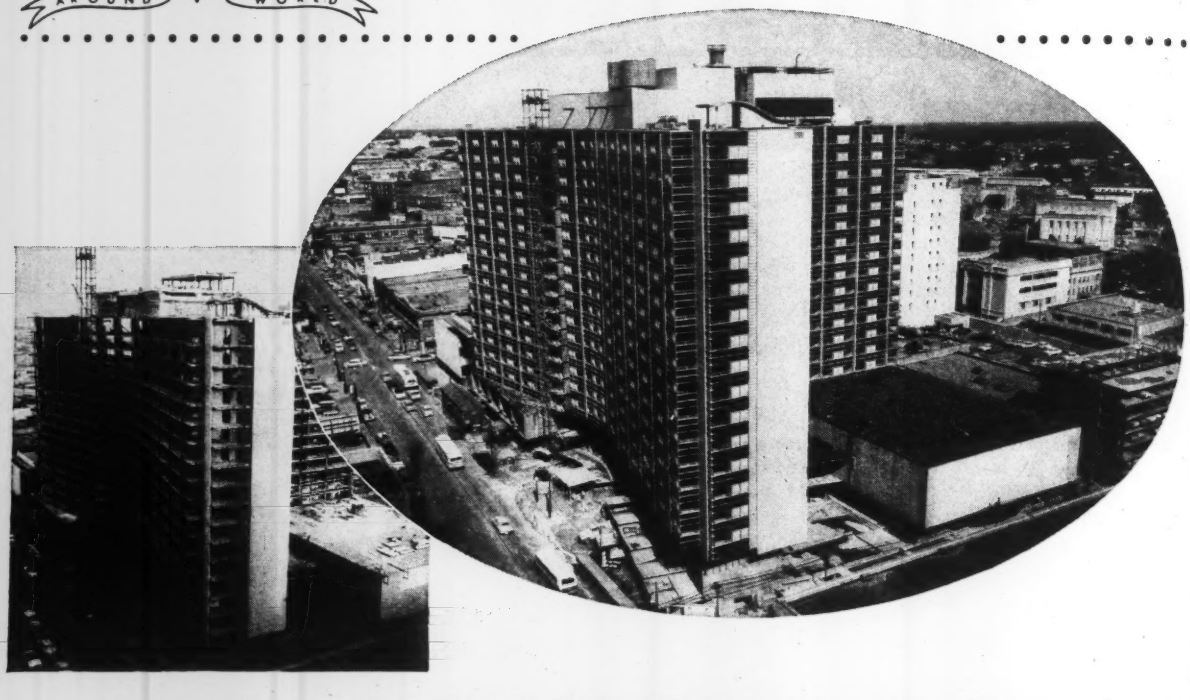
An important congress on peacetime applications of atomic developments is coming soon? With EJC as the coordinating agency, the congress and concurrent exposition will give the public its first good chance to learn of projected industrial uses of the atom. The place is the Cleveland Public Auditorium, and the dates are December 12 to 16. Details on page 69.

You missed a good meeting if you didn't get to New York in October? Induction of ten new ASCE officers, presentation of honors and awards, and an absorbing technical program were a few of the Annual Convention features. The Convention story is on page 65.

Waterpower development is being pushed all over the world? The United States has an installed capacity of about 35,000,000 hp, or some 27 percent of the world total. Since 1920 the development of waterpower for the world as a whole has increased 564 percent, whereas the increase for the United States in this period has been about 460 percent (development in the United States was greater prior to 1920). Source for these figures is a new Geological Survey report. You can get a free copy (Circular 367) from the Director of the Survey, Washington 25, D.C.

Hilton Makes Hotel History

AROUND THE WORLD



Ingenious Design Cuts Construction Costs on Dallas' 1001-Room Statler-Hilton

● Soon to open in Dallas, Texas, is the luxurious 18-story Statler-Hilton, one of the largest hotels built in 25 years, and latest in the group of 28 hotels welded together by Conrad N. Hilton into the world's greatest hotel organization.

Construction cost of this 1001-room hotel was $9,350. per room ($1.54 per cu. ft.), against an $11,000-per-room average for other new hotels in the system. The reinforced-concrete structural system not only saved money but contributed to the esthetic and functional development of the design.

Of flat-plate construction, the building is T-shaped, with three wings, each about 156 ft. long and 48 ft. wide, radiating from a central core. There are only two longitudinal rows of columns in each wing, with floors cantilevered 10 ft. beyond column centerlines to support the sandwich-panel walls. Floor slabs are 8 in. thick; no drop panels or column capitals used; only painting was required.

In this latest example of the advantages of reinforced-concrete frame construction, a total of 48,305 bbls. of Lone Star Cement was used. Equally proud is Lone Star of the part its products have played in other famous Hilton Hotels—the Waldorf-Astoria, the Shamrock-Hilton, Houston, and the new Statler-Hilton, Hartford, Conn.

As is so often the case, quality has a way of attracting quality.

THE STATLER-HILTON HOTEL, Dallas, Texas
Owner: HILTON HOTELS CORPORATION
Architect: WILLIAM B. TABLER New York
Contractor:
ROBERT E. McKEE GENERAL CONTRACTOR, INC.
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Structural Engineers:
SEELYE, STEVENSON, VALUE & KNECHT, New York
Mechanical Engineers:
JAROS, BAUM & BOLLES, New York
Haydite Lightweight Block and Aggregate supplied by: TEXCRETE COMPANY, Dallas

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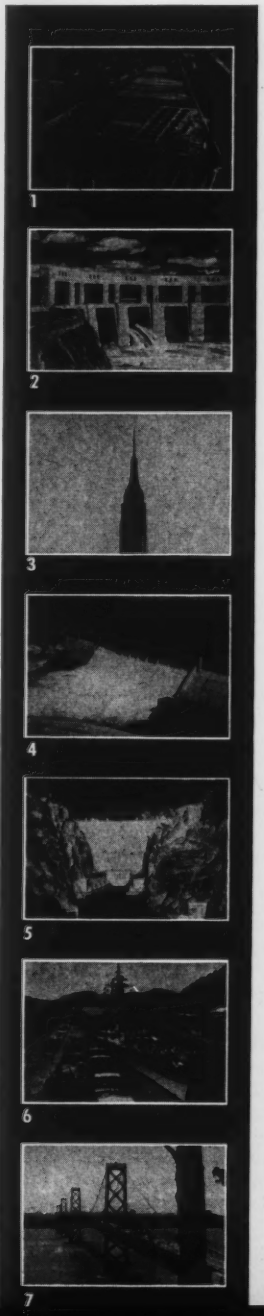
Seven modern wonders named

ASCE selects marvels of civil engineering in the United States

J. KIP FINCH, M. ASCE

Dean Emeritus, College of Engineering, Columbia University, New York, N.Y.
Chairman, ASCE Committee on Seven Modern Civil Engineering Wonders



During ASCE's Centennial Year (1952), its Local Sections were encouraged to select the seven civil engineering wonders of their respective areas. Selections were made and publicized by many Sections, representing considerable thought and effort by a large number of members of the Society. At its October 1954 meeting the Board of Direction gave further consideration to this matter and empowered President Glidden to name a committee to examine the local choices already made, to make a national selection of the seven modern civil engineering wonders in the United States, and to report its recommendations to the Board. The following members served on the Committee: Waldo Bowman, New York; Vice President Louis Howson, Chicago; Past President Malcolm Pirnie, New York; Past President Daniel V. Terrell, Kentucky; Ralph A. Tudor, San Francisco; and J. Kip Finch, New York, chairman. Mr. Bowman and Dean Finch are former Directors. After months of deliberation, during which careful consideration was given to 33 projects designed and built by civil engineers, the Committee recommended, and the Board of Direction concurred in, the selection of the following: (1) Chicago's Sewage Disposal System; (2) the Colorado River Aqueduct; (3) the Empire State Building; (4) the Grand Coulee Dam and Columbia Basin Project; (5) Hoover Dam; (6) the Panama Canal; and (7) the San Francisco–Oakland Bay Bridge. In this article Chairman Finch presents some of the major engineering aspects of these projects that have made them outstanding. The order in which these projects are named is alphabetical and has no other significance. Photos at right are numbered correspondingly

The ancient Greeks have long been noted for their modernism. It is not too surprising, therefore, to discover that some twenty-odd centuries ago they were turning out numerous guide books in which, with a truly modern touch, they listed notable sights no avid sightseer could afford to miss. Apparently the Baedeker of those early days, one Antipater of Sidon, was the first, about 200 B.C., to select a list of seven of these sights as the Wonders of the World.

The Seven Wonders of the Ancient World were: (1) the Pyramids of Egypt; (2) the Gardens of Semiramis at

Babylon, better known as the Hanging Gardens; (3) the statue of Zeus at Olympia; (4) the Temple of Artemis at Ephesus; (5) the Mausoleum at Halicarnassus; (6) the Colossus of Rhodes; and (7) the Pharos of Alexandria. These have all been destroyed except the Pyramids.

Remains of the second are thought to have been discovered but are unimpressive in scale. The third was a seated figure of Zeus of huge size, 40 ft high, made of ivory and gold over a wood frame, clearly easy to destroy and known only from early descriptions. As for the fourth, the Temple of Artemis at Ephesus, it was the fifth temple on the site, begun about 350 B.C., which stood until 262 A.D., when the Goths sacked the city. It is supposed to have had stone columns 60 ft high. The fifth wonder was erected as a tomb for King Mausolus by his Queen Artemisia in 353 B.C., and many probable restoration drawings have been made of it. The sixth was a metal statue to the sun god said to have been 150 ft high, which stood for 56 years before it was destroyed by earthquake in 224 B.C. The remains were not removed until 650 A.D., when they were sold to a dealer in old metal who, it is said, carried them away on 900 camels. The notion that it stood astride the harbor is medieval fiction. The seventh wonder, the Pharos or lighthouse of Alexandria, is said to have been 370 ft high, about the height of a 30-story building. Built by Sostratus of Cnidus shortly after 300 B.C., it reflected oriental influence in its architecture. It did not fall until 1326 A.D.

There seems to be little difficulty in discovering the basis for Mr. Antipater's decisions. Size was clearly a critical consideration for it characterized all seven selections, from the Pyramids of Egypt to the lighthouse of Alexandria. Also it is clear that the engineering accomplishments of the day did not—unless we regard the lighthouse as an engineering rather than an architectural triumph—make the guide books. Two of Antipater's wonders were tombs, two were statues of gods, and one was a temple. The lighthouse was last on the list, and the fabulous Hanging Gardens of Babylon, which are still largely a mystery, rated number two. Clearly size and artistic or architectural merit were dominating considerations in choosing these ancient wonders.

In this modern engineering age, of course, one does not have to look far to find civil engineering works of outstanding size—from great bridges and dams to long tunnels and aqueducts, from transcontinental railroads and superhighways to ship canals. We are confused not only by the number of works contesting for honors but also by another requisite that seems essential for listing as a wonder, perceptibility or seeability—capacity to be observed by, and to excite the wonder of, the sightseeing public.

Unfortunately many of the most interesting and outstanding triumphs of civil engineering skill are buried out of sight. In many cases half the cost of a great civil engineering structure is hidden in its foundations, which may indeed have constituted the most challenging and difficult part of the work. Similarly one might hesitate to nominate a tunnel for the Hall of Wonders. Yet man has probably never undertaken any task which presents a greater challenge to his skill and persistence, to his resourcefulness and determination, than that of tunnel construction. The story of under-water tubes—beginning with the Thames Tunnel in London, begun in 1825 but not completed until 1843, and including our own first Hudson-Manhattan tunnels, which were started in 1879 but not holed through until 1905—is a stirring record of daring and heroism.

In the driving of land tunnels also, nature seems to have conspired to place almost insuperable obstacles in the way of the engineer—from the Simplon Tunnel under the Alps, still the longest railroad tunnel in the world with no intermediate shafts, over 12 miles of struggle with water and rock pressure, to our own Cascade Tunnel in the State of Washington on the Great Northern Railroad. The skill of the tunnel builder has been tested to the utmost. But it is doubtful whether public opinion would accept a work of this kind as a sightseeing must. As Kipling put it, these works have been built that the Sons of Martha may deliver duly the Sons of Mary, "pleasantly sleeping and unaware."

The modern mechanical engineer faces much the same problem in attempting to present to the public what is certainly one of the wonders of the modern world—a great powerhouse. Here there is truly a modern miracle, hidden behind walls which few of the Sons of Mary have ever entered. Here less than a pound of an inert, black rock, a bit of coal you can hold in your hand, is transformed into mechanical or electrical power equivalent to the physical work of a dozen men laboring for an hour. Indeed in this matter of seeability, the civil engineer probably has an advantage over his other engineering brothers, for hidden as are many of the works or parts of works which he regards with special pride, there are many other monuments to his skill and genius which are clearly visible.

Furthermore the requirement of inspiring "open-mouthed wonder at the sight" simplifies the problem of selection. Yet there are small as well as large engineering works which have marked some notable advance in the technique of design or construction. Their number has, in fact, become almost legion. Engineering is a constantly changing, developing profession. Invention, the adoption of some strikingly new device, method, or technique, plays a part in this continuing evolution but the great bulk of engineering consists in doing better something that has been done many, many times before. Growth is through successive steps of technical evolution rather than by revolutionary change. For example, the civil engineer has known and used arch and truss bridges for centuries, and a single great arch or truss bridge built today embodies the best technical and construction skill of a multitude of bridge builders who have gone before—the professional ancestors of its designer so to speak.

If engineers, *as* engineers and *for* engineers alone, were picking out the seven engineering wonders of the modern world, they would probably soon reach the conclusion that they had embarked on a new career rather than merely undertaken a new assignment. The great strength of the profession rests on the fact that many men of diverse talents, interests and abilities have made their contribution to the technical advance of their profession. Thus any engineering nomination would naturally be selected because it epitomizes technological progress—because engineers regard it as a milestone in the long story of the increasing power of mind over matter, rather than solely because of its size.

But another vital factor which the ancients forgot would also deeply influence the viewpoint of the engineer. Engineering works have been built "for the use and convenience of man." They mark the increasing mastery of man over nature which has made possible our continuing progress toward a better life. Not only are they the outward and visible sign of the new culture and way of life modern engineering has created, but also they are the promise of a better life to come for all the world's millions. Art enriches life, but the engineer would emphasize the art and science which are a prerequisite of such enrichment.

Although this forward surge in the conquest of our environment, and promise of continued progress, received a notable impetus in Great Britain in the eighteenth century, it is primarily in the United States, and especially during the present century, that the values and potentialities of modern engineering have been most fully realized. Amer-

ican engineers have not designed and built all the engineering wonders of the modern world. To the bridge engineer at least, Britain's tremendous "boiler-plate job," the famous cantilever with two 1,710-ft spans over the Firth of Forth in Scotland, built in 1883-1890, still remains one of the engineering wonders of the world. Similarly, as the late Abbé Dimnet put it, "Ideas count more in France than facts." French engineers, from Eiffel with his famous tower, to Freyssinet with his remarkable ideas on reinforced concrete, have been noted for their success in achieving the daring rather than the obvious. More recently Swedish engineers have taken the lead from France in the concrete bridge field. In 1937-1942, they built the longest such span in the world, which crosses the Angerman River in a single leap of 866 ft. Surely such works as these belong in an Engineering Hall of Fame.

If we limit our list to works in the United States, and if we include size as a basic requirement, our selections will tend to favor the present century. Such milestones in American engineering history as the Erie Canal of 1817-1825, "America's First Engineering School," built by one state of an infant republic through 363 miles of virgin forest; such monuments of vision, enthusiasm, and courage as the Union Pacific Railroad of 1869, which not only spanned a continent but opened up a new empire; Roebling's earlier triumph, his double-deck suspension bridge of 1825-1855 over the Niagara Gorge, or his masterpiece of 1869-1883, the Brooklyn Bridge; or Captain Eads' monumental St. Louis arch of 1874, called the "granddaddy of American metal arches"—all these and other notable and historic works must be ruled out. The twentieth century takes precedence over the nineteenth when size becomes a criterion.

Not only has America come of age in the twentieth century, posing new problems to meet more insistent demands, but the civil engineer's sister professions have given him far greater resources with which to meet these expanding needs and wants. Steam, electric and gas power have replaced the hardy laborer with his pick and shovel, and his trusty helpers, the horse and cart. The mechanization of construction has paralleled the mechanization of industry, while new chemical and metallurgical products, notably steel and cement, have furnished new materials to meet new needs. The highway era is a creation of the twentieth century. It is a child of another mechanical invention, the motor car, as the Railroad Era was the child of an earlier mechanical development, the locomotive. Civil engineering has been brought face to face with new and challenging demands, and at the same time has been given new and increased resources to meet these demands, through advances in its sister arts.

Thus, our nominations for the seven modern civil engineering wonders of the United States reflect not only progress in one of the most ancient of the practical arts, construction, but indirectly, the debt which both the civil engineer and the public owe to the entire field of engineering.

In making these selections, the following criteria have been given special weight: service to the well-being of people and communities, uniqueness, pioneering aspects in design and construction, extent to which the work has been successfully copied, outstanding values both esthetic and utilitarian, and great size.

Three of the projects selected were financed by the U. S. Government. These are the Grand Coulee Dam and Columbia Basin Project, Hoover Dam, and the Panama Canal. Their costs are being paid off by the beneficiaries in the form of charges for irrigation water or tolls. As for the bridge built across San Francisco Bay by the State of California, its cost is being returned by tolls. Chicago's sewer system was financed by the Sanitary District of Chicago. Financing of the Colorado River Aqueduct was by the Metropolitan Water District of Southern California, the cost to be retired, at least in part, by charges for water. These six projects were built by public agencies for the benefit of the public. Only one of the seven wonders selected, the Empire State Building, was financed and built by private enterprise. Here again is a reflection of modern civil engineering practice—only a community of resources can meet the costs of projects which serve not the fortunate few but the millions of a modern democracy.

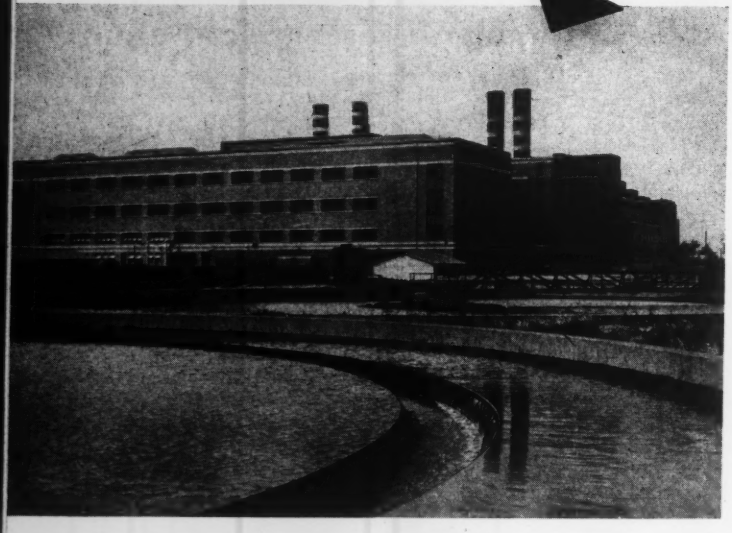
1. Chicago's Sewage Disposal System, a herculean task in sanitation

The medical profession rightly claims an outstanding share in relieving many of the diseases to which humankind is subject. While these triumphs have been widely acclaimed, we are likely to forget that the civil engineer in his role of sanitary expert has also played no minor part in the improvement of public health. Over two thousand years ago Roman engineers were bringing water into the city of Rome—an essential to community life and urban development—and the Cloaca Maxima, the ancient drainage system of the city, met in part at least another major need always faced by concentrations of humanity. These earlier efforts, however, are dwarfed by the requirements of modern urban centers, and among these Chicago is outstanding in meeting the challenge successfully.

It is unfortunately true that, in solving the problems of towns and cities, water supply has always come first. The disposal of human wastes has invariably been put off until a major catastrophe has at last forced attention to be given to this vital need. Long after Paris and London had reasonably adequate water supplies, their sewage systems were either completely lacking or woefully inadequate. Repeated epidemics of cholera finally brought this problem forcibly to public notice. The development of Chicago's remarkable sewage system has followed a quite different course although it also has come about as a result of necessity rather than choice.

Earlier practice almost invariably depended upon disposing of sewage and drainage simply by discharging it into the nearest watercourse. Chicago, however, drew her water supply from Lake Michigan and, although the intake towers were located some miles out in the lake, as the city grew it became impossible to prevent pollution if her drainage was simply dumped into the lake. Accordingly, between 1890 and 1900 the city excavated the Chicago Drainage Canal. This reversed the flow of the Chicago River, which was in effect the main sewer of the city, and carried the sewage some twenty-eight miles through a low dividing ridge into the Des Plains River, a tributary of the Illinois River, which in turn empties into the Mississippi. This was clearly a simple solution for Chicago, but, although the canal marked a now almost forgotten milestone in American construction, it

Chicago Aerial Survey Co.



World's largest sewage treatment plant is Chicago's West-Southwest Plant, here pictured, which can treat 900 million gallons of sewage daily, equivalent to wastes from a population of close to three million people. This plant, part of Chicago's record-breaking sewage disposal system, uses activated sludge process. Building shown at left is Sludge Disposal and Pump and Blower Building, with final settling tanks in foreground.

offered only an emergency solution of the problem.

This canal was one of the first great excavating jobs undertaken in the States. It came at a time when machines were replacing hand methods and the horse and cart. Special equipment was designed for the work, and it has been referred to as "The American School of Excavating Machinery."

With the opening of the canal the typhoid death rate in Chicago dropped sharply but other interests did not accept this solution of the problem without protest. On the one hand the pollution of the Illinois River ultimately raised a storm of protest, while on the other hand, the diversion of water from Lake Michigan to provide the flow necessary in the canal was subtracted from the flow allocated to the United States for power purposes at Niagara Falls under the agreement with Canada. As a result the Supreme Court of the United States, which had permitted a temporary diversion of 10,000 cfs in the earlier days, finally required the Sanitary District of Chicago to put into operation by 1938 facilities for the complete treatment of all its sewage, and to reduce the diversion from Lake Michigan through the canal to 1,500 cfs by means of control gates at the mouth of the Chicago River.

It is doubtful whether any city in the world has ever faced a more herculean task, yet the necessary plants

were built and the requirements of the court have been met.

The volume of sewage to be treated was staggering. The West-Southwest Plant, the largest in the world, is capable of treating nine hundred million gallons of sewage a day—equivalent to wastes from a population of 2,833,000 people. The three plants built by the District can provide for a population of 4,320,000 plus the industrial wastes of an equivalent population of about 3,000,000 more. These plants treat 1,100 million gallons of sewage per day—enough to cover a square mile to a depth of about five feet. It is estimated that the cost of these works has been some 310 million dollars.

Thus the discharge into the Drainage Canal is now rendered inoffensive; in fact, a BOD (biochemical oxygen demand) removal of 85 to 95 percent is required. How is this accomplished? The answer is, by putting bacteria to work and speeding up natural processes. But it has taken a tremendous amount of study and research to determine the most favorable conditions for bacterial growth—even down to the size of the air bubbles used in aerating the sewage. In addition, the varying composition of the sewage, the character of the industrial wastes and their proportion to the domestic wastes, and other factors such as temperature, vitally affect the process.

At Chicago, where the combined system is used, that is, where the sewers carry not only industrial and domestic wastes but storm runoff from streets and houses, the first problem is to remove the grit and such solids as garbage, paper, fabrics and other like material. This is done by sedimentation, after which the sewage is oxidized by having air blown through it, whereupon the aerobic bacteria get to work. The organic solids in the sewage gather in small flocculent masses and can be settled out as sludge. Needless to say, this sludge is high in bacteria and it has been found that by mixing it with the incoming sewage it will form, not only food and lodgment for the nitrifying bacteria already in the raw sewage but also for the enormous numbers of bacteria that develop under the favorable conditions maintained in the mixture of sewage and sludge. This technique, known as the activated sludge process, although known before World War I, has become the leading process only in comparatively recent years.

Thus the Chicago Sewage Disposal System, generally acknowledged because of its great size to be one of the wonders of modern engineering, depends, in its operation, on the cooperation of the very small—hordes of microscopic bacteria.

2. Colorado River Aqueduct, longest man-made conduit

Millions of people and hundreds of square miles of fertile land in Southern California are dependent on the importation of water from outside sources. Modern civil engineering design and construction techniques have made it practicable to bring in this water in large quantities and from distances once considered unthinkable. The Colorado River Aqueduct—part canal, part tunnel, part siphon—taps the river of that name nearly 250 miles from the area where the water is to be used. Across a forbidden desert and through some 120 miles of tunnels and siphons, it will eventually carry 1,600 cfs of water, making possible the development of that remarkable group of cities which constitute the Los Angeles area.

Even when Los Angeles was a small Mexican town, its natural water supply was so scanty that it had to be augmented, originally by artesian wells, pumps, and ditches. In 1906-1913 the Owens Valley Aqueduct was constructed on the eastern slope of the Sierras to bring 450 cfs of water to the city. The great Colorado River Aqueduct, begun in 1932 and finished in 1939, has been Los Angeles's answer to this ever-increasing need for water.

Southern California is in an arid but fertile area generally called the South Coastal Basin, where rainfall varies from 6 to 26 in. yearly and averages about 15 in. When the white man first came to this region, the underground basins were full to overflowing. Strong artesian flows were available over an area of more than 300 sq miles. Then came the time when withdrawals from the underground basins exceeded the natural replenishment; wells ceased to flow. When pumps were installed, the ground-water levels dropped still further, far beyond the point where the storage could be replaced by rainfall alone. In some locations, ground water fell below sea level, and salt water intruded into the underground basins.

Thus it became evident that the importation of water from outside the local area was essential to the continued growth of Los Angeles. This was in 1906, when steps were taken by the city to build the Owens Valley Aqueduct.

By 1923, however, it was estimated that double the amount of water then available would be needed in the predictable future. Engineers of the city's Department of Water and Power began to examine the feasibility of bringing water from the Colorado River. Neighboring communities became interested in the undertaking with the result that 13 cities joined in the formation of the Metropolitan Water District of Southern California. In May 1930, the District took over the planning for the $220,000,000 Colorado River Aqueduct.

The Colorado River is topographically separated from the District by a major divide and is lower than much of the area to be served with its water. Gravity flow would be possible only from behind a high dam far up the river, and then only through several long, deep, and costly tunnels. Therefore it was decided to rely on pumping, and a location for the diversion was chosen on this basis.

Careful study of the terrain led to the decision to start the aqueduct at a point on the river 16 miles above Parker, Ariz., and 155 miles downstream from Hoover Dam. Here the engineers of the Bureau of Reclamation built Parker Diversion Dam with funds furnished by the District. This concrete-arch structure raises the level of the river 70 ft, but because of the great depth of silt and gravel over bedrock, the foundations were carried down 250 ft, so that the dam is 320 ft high.

A stretch of hot and barren desert 242 miles long lies between the beginning of the aqueduct at this dam and its terminal reservoir, Lake Mathews, 10 miles south of Riverside, Calif. This desert area is cut at frequent intervals by rocky ridges and scarred by numerous washes. To build the aqueduct across zones of crushed rock, water-bearing gravels, and earthquake faults (particularly the San Andreas Fault), taxed the engineers' skill and the contractors' ingenuity.

Since tunnels are very costly, it was decided that the water would be pumped part way up the rocky ridges, thus avoiding the need for, or reducing the length of, the tunnels. This plan involved an interesting balance of expenditures between the costs of pumping and of tunneling. These studies resulted in providing a total pumping lift of 1,617 ft, divided among five elec-

Water is started on its 556-mile trip down the Colorado River Aqueduct by being raised 291 ft at Whitsett Intake Pumping Plant (upper photo). Parker Dam on the Colorado River backs up the water to feed the huge pumps in this plant. After passing through four more pumping plants, this water will eventually supply the needs of 66 cities in the Metropolitan Water District of Southern California. Part of the way it will flow through concrete-lined canal across desert country, as shown in lower photo. Other parts of the aqueduct take the form of tunnels, covered concrete conduits, inverted siphons, and pipelines.

trically operated pumping plants, the individual lifts being from 144 ft to 441 ft in height.

The conduit includes several types of construction: 92 miles of 16-ft horseshoe-shaped tunnel, mostly concrete lined; 54 miles of cut-and-cover unreinforced concrete conduit; 63 miles of open lined canal, generally 20 ft in bottom width; and 29 miles of inverted concrete-pipe siphon, only one of the two 12.7-ft-dia pipes ultimately planned being built at each siphon location in the initial construction. A desilting system at Parker Dam removes the heavy burden of silt carried by the Colorado.

Of the 31 tunnels on the line, that at San Jacinto is the longest. It runs through a spur of Mount San Jacinto for a distance of 13 miles. During construction, which was by District forces, large flows of water under heavy pressure, frequently as much as 250 psi and in places 600 psi, blocked progress. The installation of a 16,000-gpm pumping station in each of two shafts solved this problem.

This tunnel was recognized as a major problem and was the first feature of the aqueduct to be started. In fact, its completion in 1939 marked the completion of the aqueduct itself. This great aqueduct involved 30,800,000 cu yd of excavation, 4,037,000 cu yd of concrete, 6,059,000 bbl of cement, and 116,000 tons of reinforcing and structural steel.

Since the aqueduct was finished, fast-growing, water-starved San Diego County has become a member of the District. Two pipelines, each with a capacity of 100 cfs, have been built to carry water from the aqueduct to this center of Navy activity. The Metropolitan Water District includes 66 cities in the five counties of Southern California, within which six million people live. This is close to half the population of the state. Thus, by building the longest water conduit ever undertaken by man, provision has been made for the continued growth of a most active and vitally important area of our country.

3. Empire State Building, queen of skyscrapers

At first sight the skyscraper may appear to be an architectural rather than an engineering triumph. It has been made possible, however, entirely by engineering advances. Its skeleton of steel is a development from bridge construction, and its design, as well as that of the deep foundations on which it often rests, is invariably entrusted to civil engineers. Mechanical and electrical engineers have played a part in making higher buildings feasible, for without elevators no building over, say, six stories would be rentable. It has been said that "The skyscraper is the most distinctly American thing in the world. It is all American and all ours in its conception." Although primarily a twentieth century product, its evolution runs well back into the nineteenth century.

The earliest step was the development of the elevator. In 1859 the famous Fifth Avenue Hotel in New York was built and, although only six stories high, equipped with an elevator, which was regarded as the last word in

comfort and magnificence, in convenience and modernity. It was a screw elevator, the cab being raised and lowered like a nut on a screw shaft operated by a steam engine. A steam-hoist "suspended elevator" followed in the St. James Hotel in New York in 1866, and the hydraulic plunger type of elevator held the stage in the seventies. Then, the advent of the first practical electric elevator, in 1889, was responsible for an increase in height of buildings to ten stories.

At this point another limiting factor began to affect skyward progress. The masonry walls of all these earlier buildings not only were self-supporting but were also "bearing walls," that is, they carried the dead weight and the live loads of the floors above. As a result they had become of fortress-like thickness at the street level. The walls of the 16-story Monadnock Building in Chicago, for example, were 5 ft thick at the first-floor level.

A preliminary step toward the skeleton frame had been taken in 1853 in the Harper & Brothers building in New York, the first "fire-proofed" building. Here wrought-iron beams with brick arches between replaced the earlier wood beams and floors. A further transitional step was then taken to reduce the wall loads by building cast-iron columns into the walls. Then the scene shifted to Chicago.

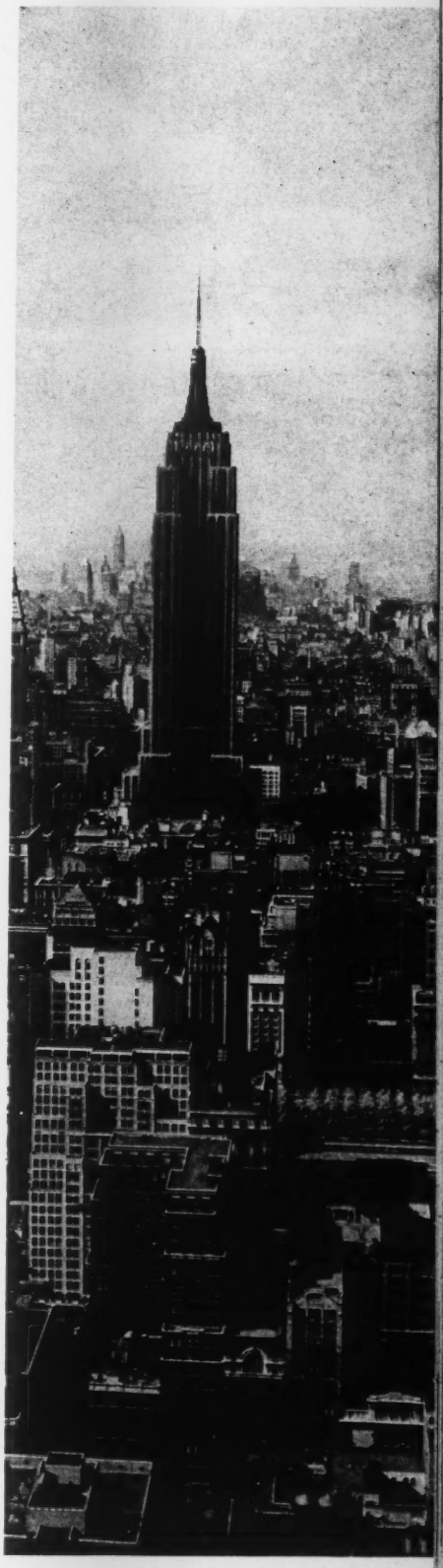
Here, in 1884, the 10-story Home Insurance Building was erected of "cage construction," that is, with its floors entirely carried by wrought-iron beams framing into cast-iron columns. Its walls were simply self-supporting. Only three years later, the next step was taken in the 14-story Tacoma Building, in which even the outer walls on the two street frontages became simply "curtain walls," that is, enclosing walls, and their weight at each floor was transmitted to and carried by the columns. The modern skyscraper was born, and here for the first time "sidewalk superintendents" saw bricklayers beginning to lay walls "midway between roof and ground."

The failure of a 13-story apartment house in New York that had been built with cast-iron columns, plus the advent of steel in construction, resulted in the first building with an all-steel skeleton, the Rand-McNally Building erected in Chicago in 1889. Thereafter the scene shifted back to New York, and the rise skyward was under way. It culminated in the Empire State Building, constructed in 1930 to a height of 102 stories or 1,250 ft. To this a 222-ft television tower has since been added, extending the height to 1,472 ft.

This, the tallest building man has ever erected, has held the honor for twenty-five years. Soon after this building was constructed it became necessary to limit the heights of buildings if New York streets were to handle the crowds which such buildings could accommodate. The new building law permits towers to be built but covering only one-quarter of the lot. Furthermore, the rentable area is reduced by the space necessary for the batteries of elevators needed to service the many tower floors. Thus the law and economic considerations combine to produce the present "stepped-back" construction of more modest height.

It is therefore probable that the Empire State Building will retain its height record for some years to come. But, although this steel mountain seems safe in its position as the world's tallest building, it would be unreasonable to claim that it is the most interesting tall building from the engineering standpoint. No unusual foundation conditions were encountered at the site, and the frame, containing some 57,000 tons of steel, was erected in six months.

Brother engineers in Chicago will recall the famous Merchandising Mart, completed in 1929, which, although only 18 stories high, is the largest building in the world, containing 53 million cu ft of enclosed space. Similarly, stories of those venturesome souls who have entered the Pentagon in Washington and wondered lost for weeks have become legion. But the Empire State Building still represents man's nearest approach to the clouds. Few are disappointed with its impressive height, although it is reported that a visitor from the Near East, apparently expecting that the tops of skyscrapers actually would be hidden in the clouds, remarked as his steamer came up the harbor and the New York skyline came into view, "Why, we have mountains that high at home."



World's tallest building, Empire State, is silhouetted against the sky in downtown Manhattan. Television tower 222 ft high raises total height of this 102-story building to 1,472 ft. Among world structures, the tallest steel structure ever erected is the guyed television tower for Oklahoma City's Station KWTV, which is 1,572 ft high. Two other guyed steel towers are next in height to the Empire State Building, the radio transmission tower at Forestport, N.Y., 1,218 ft, and that at Thule, Greenland, 1,212 ft. Among buildings, next in height to the Empire State is another Manhattan Island skyscraper, the Chrysler Building, rising 77 stores to a height of 1,046 ft. The Eiffel Tower in Paris is next, at 985 ft.

4. Grand Coulee Dam and the Columbia Basin Project, irrigation marvel

Grand Coulee Dam, in foreground, contains world's largest single mass of concrete, over 10 million cubic yards. Another "world's largest" is the hydroelectric power plant housed in the two powerhouses. Part of this power is used to lift water by pumps, also world's largest, into 25-mile-long Grand Coulee, in background, whence it flows down to irrigate an area larger than the State of Rhode Island.

Late in the nineteenth century, pioneer farmers moved into the Columbia Basin area of eastern Washington. While the average annual rainfall is just under 8 in., and less than half of this occurs during the six-month growing season, these pioneers, following dry farming methods, grew principally wheat, although in dry years even the wheat crop failed. As early as 1904 the U.S. Bureau of Reclamation, established only two years earlier under President Theodore Roosevelt, investigated the possibility of providing irrigation for the agricultural development of this area. It was not until 1932, however, that a great project for the utilization of the Columbia River was finally approved, and seven years later, in 1939, Grand Coulee Dam was completed.

The dam and its accompanying works exemplify on the one hand the remarkable scope of the constructive vision and planning abilities of the modern civil engineer, and on the other the tremendous resources and power he has at his disposal in bringing into being the children of his creative imagination. Grand Coulee can provide water for the irrigation of a million acres, an area larger than the entire State of Rhode Island. It also involves the largest hydroelectric power plant in the world. In part its power output is used to pump water to the lands to be irrigated, which are high above the river. A single one of the centrifugal pumps installed for this purpose—these pumps are the largest in the world—could handle all the water needed by the City of New York. The dam itself involved making and placing the world's largest single mass of concrete, over $10^1/_2$ million cubic yards—equal to a shaft of concrete standing on and filling a city block, and over half a mile high. But this colossal undertaking also has a most interesting topographic background, of which the engineers had the vision to take full advantage.

Geologists tell us that a huge glacier pushed down from the north during the ice age and dammed the deep gorge of the Columbia River near the upper end of a great half loop in the river known as the Big Bend. This forced the river to cut a new valley across the bend and, when the glacier receded and the river returned to its original bed, this great valley, the Grand Coulee, was left high and dry above the present stream bed.

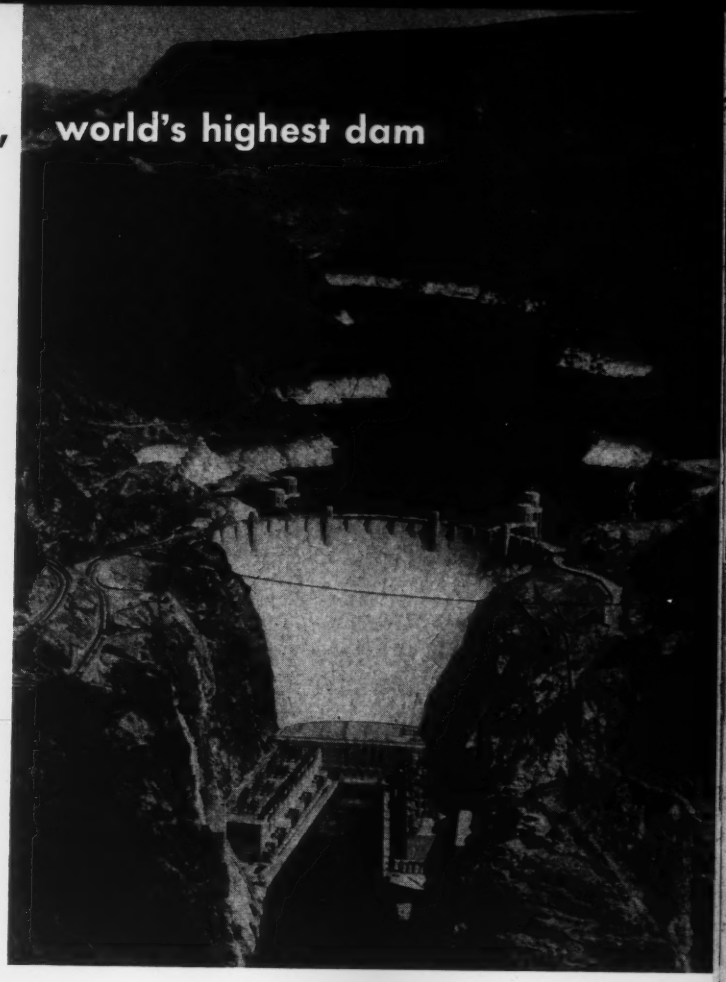
While it was proposed at one time to build a dam high enough to raise the river level up to its old ice-age bed, whence it would flow some fifty miles to Soap Lake at the upper end of the area to be irrigated, the possibilities of power development at the site afforded a far more realistic solution of the problem. Furthermore, it was undesirable to extend the reservoir over the Canadian border 151 miles away. The Grand Coulee Dam, 550 ft high, raises the river level part way up to the level of the Coulee. The huge pumping plant raises the water the rest of the way.

Work on the dam began in 1934 and it was completed in 1939. A modern construction plant and mechanical equipment made it possible to provide the basic materials and to mix and place concrete in this stone mountain at a rate which reached over 400,000 cu yd in one month. Inside the dam are inspection and drainage galleries, valve and pipe chambers, and even offices and elevators. The twin powerhouses, one on each side of the river below the dam, each house nine 108,000-kw generators. For long periods, the flow of the river has permitted a continuous output of 2,200,000 kw—the largest power production of any plant in the world. Three of the pumps used to lift the irrigation water to the 25-mile-long equalizing reservoir in the Coulee, have been installed. Each of these pumps has a capacity of 1,600 cu ft per sec. Space is provided for nine more of these monsters, to be installed as needed.

At each end of the 25-mile-long Grand Coulee, an earth dam creates a huge equalizing reservoir into which the pumps discharge. From this reservoir, feeder and distribution canals, pipelines, siphons, and dams to create smaller equalizing reservoirs, are being built to serve the land as it is occupied and prepared for farming.

It has cost over 500 million dollars to give being to this tremendous creation of the engineering imagination. Some 70 percent of this cost is allocated to irrigation, 20 percent to commercial power, and 10 percent to other benefits. While it may be many years before agriculture can carry its share of this large cost, the Grand Coulee, with relatively cheap hydroelectric power, is one of the major factors in attracting to the State of Washington those plants in which the availability of large amounts of power at low cost is a vital and determining factor. Nature has been harnessed to meet man's needs on a scale that not so long ago would have been regarded as completely visionary and impossible.

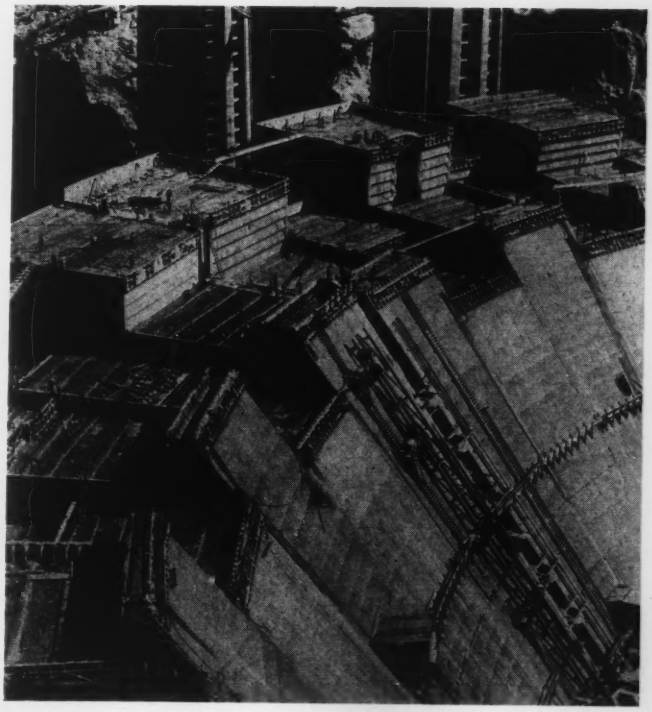
5. Hoover Dam, world's highest dam



It has been said that when bigger and better dams are built, the U.S. Bureau of Reclamation will build them. In fact the Bureau has built so many record-breaking dams that it is difficult to choose among them. One hesitates, for example, to name Hoover Dam in preference to Grand Coulee, with its total volume of over $10^1/_2$ million cubic yards of concrete. Yet Hoover Dam, or Boulder Dam as it was first called, still holds the record for height, 726 ft—almost as high as the Woolworth Building. Its $3^1/_4$ million cubic yards of concrete, since dwarfed by the cubage of the longer and lower dam at Grand Coulee, at the time of its construction in 1931–1936 established a record. It set a new level of attainment in the mastery of mind over matter that has caused later gigantic works of this kind to be accepted as more or less routine.

To a visitor stepping out on the observation platform at Boulder Canyon today, and looking down on the dam with the powerhouse at its foot, and Lake Mead behind it stretching some 150 miles up the Colorado River, the sight is certainly impressive. Had the visit been made during the last stages of construction, however, the scale of this great undertaking would have been even more striking. The men working on the huge vertical blocks of concrete appeared to be mere ants, patiently laboring at what seemed an interminable task. Unlike the Panama Canal, Hoover Dam was not built by the forces of the Federal Government. Designed by the Bureau of Reclamation, it was built under contract by the Six Companies, a partnership of construction firms joined together in demonstrating the ability of American free enterprise to successfully carry through an epoch-marking work.

Hoover Dam may be regarded as a hybrid structure—both an arch and a gravity dam. One of its parents was of Spanish ancestry going back to the



Hoover Dam, world's highest dam, is a combination arch and gravity structure. During construction, the men working on the great blocks of concrete appeared to be mere ants. See construction view at right. Dam was raised in alternate blocks to help dissipate the heat of hydration of concrete, a serious problem in large concrete dams and one which has taxed the ingenuity of engineers. Many other design and construction problems were successfully solved before the completion of this dam, which has held the world's record for height for nearly twenty years.

sixteenth century. The other, far more recent, was born in our Western States in the late nineteenth century.

On the Spanish side is the gravity aspect. A "gravity" dam is simply a masonry wall, which resists water pressure by turning it downward to the base, solely by reason of its weight because it is sufficiently thick and heavy to be safe against overturning or sliding. In fact, as the engineer would put it, the early Spanish gravity dams were not "rationally" designed structures. They were simply massive walls. A bit over a century ago, a French engineer, de Sazilly, developed a refinement of this principle. He showed how a more effective dam could be built and material saved by using a more or less triangular cross-section—making the wall wide at the base, with the face sloping upstream to a thinner section at the top.

British colonial engineers in India were the first to apply de Sazilly's "profile" in building some of the earliest gravity dams—really remarkable works for their day. American engineers entered this field late in the story but, with true American spirit, captured the world's height record in the first great dam built in the United States, the New Croton Dam of 1892–1907, which is 297 ft high from the bottom of its foundations to the roadway on its top. Records for dam height have since remained in the United States, although Grand Dixence in Switzerland, a gravity dam 921 ft high, when completed will top Hoover Dam by 195 ft.

While the great American gravity dams of the earlier period were built for public water supplies in the East, the Bureau of Reclamation, organized in 1902, has been responsible for the greatest modern works, the irrigation structures of the West. And there, in deep narrow canyons, a new form of dam appeared, the arch dam. This type is essentially a masonry arch with its axis vertical instead of horizontal, resisting the water pressure behind it by its action as an arch, the steep side walls of the site serving as abutments to carry the thrust. This form avoids some of the foundation difficulties of the gravity type and requires far less masonry. Between 1905 and 1910, the Bureau built a dam of this form in a narrow canyon in Wyoming—the Shoshone Dam, a wonder of its day. Its height of 328 ft—higher than the famous Flatiron Building—broke the record, but it was only 200 ft long at the crest.

Clearly this type of dam was for deep and narrow canyons, but the same principle could be used under somewhat less favorable site conditions for a hybrid structure—one that carries its load in part by arch action and in part through its weight, the gift of gravity. This plan of course involves a pretty problem in mechanics. To what extent can we count on one form of action and to what extent on the other? Bureau engineers worked out a solution of this problem and did not hesitate to undertake the design of the highest dam in the world on this combination arch-gravity basis.

But this plan raised another problem. Engineers well know that when cement "sets," a chemical reaction takes place and the concrete becomes heated, only to shrink later when it cools. It would take years for the huge mass of concrete in a great dam to cool naturally, and any shrinkage cracks would produce leaks or, in an arch dam, would prevent arch action. Both for construction reasons and to localize such unavoidable shrinkage, great dams are not built as monolithic structures but in alternate blocks, the intervening blocks being poured after the first have cooled. The cooling process is sometimes hastened by circulating cold water through a network of pipes laid on top of each lift of concrete. After cooling has taken place, the joints between the huge concrete blocks are sealed by grouting—forcing in semi-liquid cement mortar. Needless to say, this was a major construction problem on Hoover Dam.

When an engineer sightseer visits this dam he sees, beyond the wonder of its size, the problems its builders faced, and beyond these again, the long and fascinating history of the efforts of his engineering ancestors to build bigger and better dams. To this history, Hoover Dam added a new and stirring chapter.

The building of the Panama Canal not only constituted a challenge to the American civil engineer, it was a challenge to the entire nation. Envisioned by early Spanish explorers, it had remained for centuries no more than a dream. France, fresh from the triumph of the Suez Canal, and represented by its great builder, de Lesseps, the foremost canal expert of the day, had endeavored heroically to sever the western continents and failed. The United States fell heir to this greatest of geographical surgical operations.

At least four men deserve to share the honors of America's achievement at Panama. One was a political leader, one a doctor, and two were civil engineers. President Theodore Roosevelt cleared the diplomatic and financial difficulties out of the way. Dr. William C. Gorgas, of the Army Medical Corps, stamped out "yellow-jack" which, it is said, made the price of the earlier Panama Railroad one man for every tie in the roadbed. John F. Stevens, Honorary Member and President of ASCE, made the dirt fly. He was one of the last of the strong, determined and resourceful engineer leaders of the romantic days of railroading in the West. And Colonel (later General) G. W. Goethals, M. ASCE, Army Engineer and hydraulic expert, built the locks and completed the construction. The canal was begun in 1903, and the first ship passed through in August 1914.

No distinctly new engineering techniques, no new designs or unique methods of construction, were involved in this great work. But the scale of the undertaking was unprecedented. The excavation through the backbone of the continents of the western hemisphere, notably in the great Culebra Cut, was a steam-shovel task, a railroad building technique. It involved excavating and carrying to spoil banks 270 million cu yd of earth and rock.

Locks have been used for at least five centuries, and the mitering lock is supposed to have been Leonardo da Vinci's most important engineering invention. These Panama locks were not new, but the sizes were. The locks, dams and other concrete construction

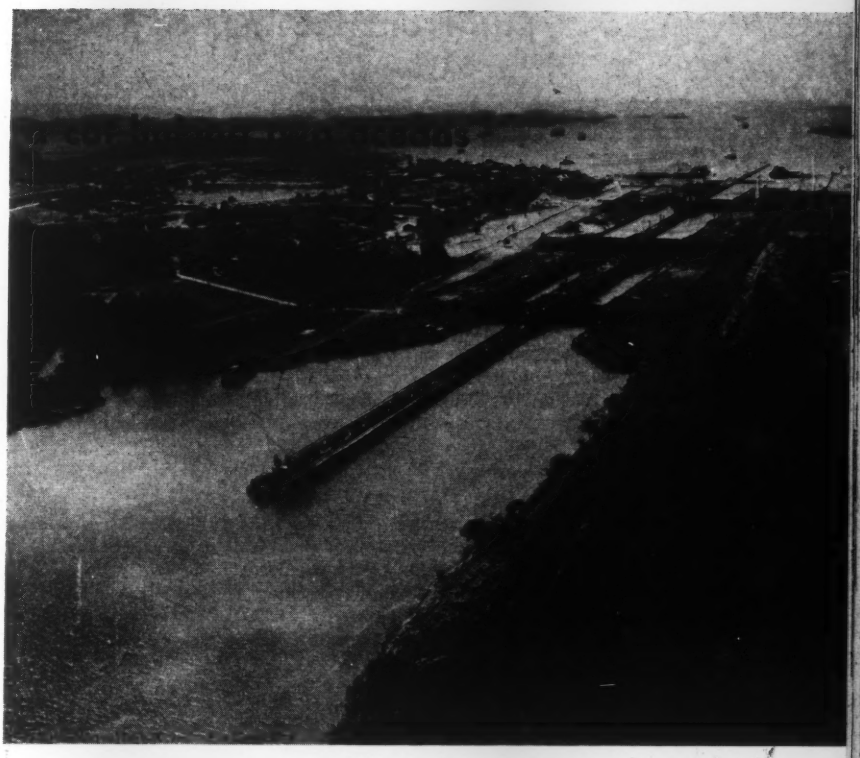
6. Panama Canal,

at Panama contained some 4.8 million cu yd of concrete.

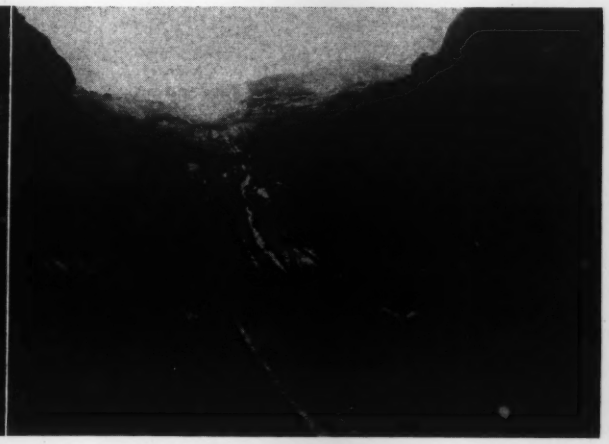
A canal passing over a divide requires a water supply at the summit. This problem also had been faced and met in the seventeenth century in France, notably in the famous Canal du Midi of 1681, the Panama Canal of its day. At Panama, the Chagres River and the great storage reservoir (as well as canal channel) formed by the Gatun Dam, met this need.

Much of the feeling of magnitude, of stupendous scale—a full appreciation of the stubbornness, persistence and patience of man in overcoming a great natural obstacle—is lost to the sightseer who passes through the canal in a luxury steamer today. Over 40 ft of water covers the lower part of the Culebra Cut and the locks and their massive gates.

The Panama Canal has no real counterpart anywhere in the world. Probably no other engineering structure has been so widely beneficial to trade and commerce, and the extent of its service has not decreased over the years. In the 40 years since it was built, 230,000 vessels of all types have passed through it. The design and the construction methods used on this engineering wonder have been copied many times since, to the great credit of those who built it.



To sever two continents and so link two oceans, the Panama Canal was built in 1903–1914. Probably no other engineering structure has been of such benefit to trade and commerce, and its importance has increased over the years. Although no strictly new designs or construction methods were involved in this work, its scale was unprecedented. Upper photo shows Gatun Locks, with Gatun Lake, high point of the canal, in background. At lower left is one of murals in rotunda of Panama Canal Administration Building, depicting monumental lock construction. Photo at lower right shows Gaillard Cut, at point of deepest excavation for the canal, as seen in June 1913. It was here that the principal excavation was required.



7. San Francisco-Oakland Bay Bridge, unique over-water steel structure

The top ten or more bridges in the world today, listed according to span length, are all suspension structures, and the problem of selecting the outstanding bridge of this type becomes increasingly difficult. On the basis of span length alone, the Golden Gate Bridge at San Francisco, with its unsupported-span length of 4,200 ft, and the George Washington Bridge over the Hudson at New York, with its clear span of 3,500 ft, are at the top of the list—but probably only temporarily, for spans of over a mile in length are being actively planned. Yet both these structures doubled, or more than doubled, the span lengths of a few years earlier.

There is one other contender for first place as a marvel of suspension bridge construction, although its claim is not based on a single clear span of record length. This is the San Francisco-Oakland Bay Bridge, which finally was selected as the outstanding wonder among the bridges of the United States. Its total length of steel over water is about six miles, and its twin suspension spans, built end to end, are each 2,310 ft long. Between them, however, is a great center anchorage pier, certainly one of the most remarkable examples of foundation and pier construction

Chosen as outstanding wonder among many fine bridges of the United States is San Francisco-Oakland Bay Bridge. Twin suspension structures, placed end to end, carry continuous cables for total length of about 4,630 ft. These twin spans connect San Francisco, seen in distance, with Yerba Buena Island, which appears in foreground. Between the two suspension structures is great center anchorage pier, clearly seen just beyond prow of ferryboat at left. It extends below water 242 ft, or 140 ft below the bottom of the bay. Towers which support the cables are 500 ft high, to provide a generous 209-ft clearance for shipping.

the world has ever seen, and a major factor in the selection of this bridge among its many competitors. Unprecedented features were the depth of this massive foundation, which was carried more than 240 ft below the water surface, and the design of the unique domed dredging wells, which permitted the use of compressed air to control the flotation and sinking of the great foundation caisson.

The huge caisson for this pier, the largest ever used (92 × 197 ft), was floated into position and sunk in 100 ft of water in spite of swift tidal currents. Great difficulty had been experienced, during the sinking of the smaller "boxes," in keeping them in a vertical position. They were sunk by open dredging, that is, by taking out material from inside them with mechanical excavating buckets. Yet the mammoth caisson was finally sunk successfully by the ingenious plan of capping those of its 55 dredging wells not being excavated at the time, and forcing air into them as required to provide buoyancy. Thus this huge cellular box was held in a level position while being sunk to sound material 140 ft below the bottom of the bay.

For a distance of nearly two miles between San Francisco and Yerba Buena Island, the twin suspension spans of this bridge extended across the bay, clearing the water by 209 ft, enough to accommodate all types of shipping. The two suspension cables are stretched over four 500-ft-high towers between the massive concrete anchorages, one on the San Francisco shore, the other on Yerba Buena Island. Each cable is over 4,630 ft long.

The upper deck of the bridge is wide enough for six lanes of automobile traffic; the lower deck provides three lanes for trucks and two tracks for rapid transit. These two decks of traffic are carried through Yerba Buena Island, which is high and rocky, in the world's largest tunnel. This tunnel is 540 ft long.

Across the eastern part of the bay, a cantilever of 1,400-ft span—one of the long cantilevers in the country—clears the deep-water channel by 191 ft. The bridge continues to the Oakland shore on a series of 504-ft through trusses and 288-ft deck trusses. The entire bridge, from Fifth Street in San Francisco to the Oakland toll plaza, is just over six miles long. Construction was started in 1933 and completed in 1936. The cost was $71,000,000.

Each of the two cables of the twin suspension bridges is 28 3/4 in. in diameter, and each contains 17,464 separate wires laid parallel to one another. Each wire is about a fifth of an inch in diameter. The surprising total is 70,815 miles of wire, or enough to circle the globe nearly three times at the equator. With maximum changes in temperature and load, the sag in the cables (as well as the level of the center of the span) slowly rises and falls as much as 11 ft.

A long history of development and failure lies behind this highly successful example of the bridge builder's art. The suspension bridge is one of the oldest of bridge types. Primitive people the world over, from ancient times to the present day, and from South America to the frontiers of China, have spanned streams with suspension bridges using handmade ropes and other native products. Yet, among civilized people the suspension bridge is a newcomer; not over a hundred and fifty years have passed since James Finley of Fayette County, Pennsylvania, pioneered in building this type of structure. In short, western civilization waited until a more reliable and permanent material than fiber rope was available before adopting this surprisingly universal type of structure.

With the advent of wrought iron, in sufficient quantity and at a low enough cost so that it could be used for other purposes than tools, weapons and fastenings, the modern suspension bridge was born. But in its brief life, this type passed through a relatively long period of waiting before it emerged in the twentieth century as the king of bridges, holding today the world's record for length of an unsupported, clear span.

The basic development of the suspension bridge, the method of "spinning" the cables, came comparatively early in its history. Finley's bridges were "chain suspensions," built of wrought-iron links. The famous British pioneer road and bridge builder, Thomas Telford, set a record with his 579-ft span over Menai Straits in 1826. For this he used a cable built up of groups of wrought-iron bars, each bar welded to the next, end to end, to form a continuous strand. Then, in 1830, a famous French engineer, Louis Vicat, pioneered in developing the spinning method for building up a cable composed of a number of parallel wires. Special high-strength steel wire has since been developed, and Vicat's spinning method has been perfected until today 16 wires can be carried across with each trip of the spinning wheel, but the basic technique is still that of 1830.

In the years before the Civil War, wire suspension passed through a period of disrepute. Finley, the American pioneer, appears to have favored a combination structure, a light wooden truss supported by a suspension chain. Of course that was in the days of light-weight horsedrawn and foot traffic. There appeared to be no need to provide stiffer trusses in order to distribute these light loads over a longer length of bridge and thus avoid excessive local deflection in a structure that was inherently flexible. The suspension bridge thus became simply a light timber floor hanging from wire cables and having little longitudinal stiffness. Disaster followed. Even Telford's famous span undulated under wind action, while Col. Charles Ellet's record-breaking span of 1,000 ft over the Ohio River at Wheeling, built in 1851, was completely wrecked by wind action three years later. These were but two of several similar failures which were to be echoed a century later when the Tacoma Narrows Bridge fell into Puget Sound as a result of the same wind action.

It was John A. Roebling, M. ASCE, who kept the suspension idea alive. He took no chances with possible distortion due to wind action, and in his famous double-deck span 825 ft long over the Niagara Gorge, built in 1855, he not only used a stiffening truss but also provided "hold-down" cables sloping down from the bridge to the sides of the gorge. Similarly, in the design for his most famous work, New York's Brooklyn Bridge, built in 1883, where such tie-downs were ruled out by navigational requirements, he provided the diagonal stays, "storm cables" as he called them, which are such a characteristic feature of this spider web in steel.

But the suspension bridge was clearly not suited to carry heavy railroad loads. In the end Roebling's Niagara span proved inadequate to withstand the ever-increasing weight of locomotives. In railroad work, trussed cantilever bridges held the long-span records. In fact it was not until 1926 that the long-span record was won back by the suspension form. This type only regained its supremacy with the advent, after World War I, of the modern highway era, bringing a demand for long spans to carry relatively light loads.

Such is the story of the suspension bridge, of which the twin spans of the Bay Bridge form a unique example. The bridge itself is seen and admired by many, but only the top of the great central pier shows above water to remind us of one of the most notable features of its construction.

Surely any modern Antipater selecting Seven Wonders for his guide books would include this colossal structure which so gracefully, and apparently so easily, carries two levels of traffic across San Francisco Bay.

EJC builds national and regional unity in the engineering profession

CARLTON S. PROCTOR, Past President ASCE, Moran, Proctor, Mueser & Rutledge, Consulting Engineers, New York, N.Y.

Engineers Joint Council as now organized includes three classes of memberships: Constituent Society, a national engineering society with acceptable membership of at least 5,000; Associate Society, a national engineering society with acceptable membership of less than 5,000, and of a professional and ethical character to justify attainment of Constituent Society status when it reaches required minimum membership; and Affiliate membership.

The constitution of EJC provides for the admission of two types of Affiliate membership: engineering societies that are regional rather than national in geographic scope, and federations of engineering societies or of local sections of national societies when the federations are broadly representative of the engineering profession—and for both classes of Affiliate membership, when the majority of the societies or local sections in the federations, or the regional society affiliate, have professional qualifications for their voting members equivalent to the requirements for Constituent Society membership in the Council. The by-laws, as approved at the last council meeting, provide "that a federation otherwise eligible for Affiliate membership shall comprise at least two societies (or sections or chapters of societies) with a total regional membership of 500 or more." For example, the Los Angeles Council of Engineering Societies recently became the first Affiliate member.

A proposal for individual membership in EJC, when submitted to the eight Constituent Societies in April 1954, received only four approvals, including that of ASCE. Hence there is no provision for individual membership.

Widespread interest in the recently established provision for Affiliate membership in EJC and the increasing demand for such Affiliate membership are healthy manifestations of the engineer's growing realization that he is more than a scientific technologist, more important to society than as a technician providing his knowledge and experienced judgment in fields of applied science. He has awakened to the fact that he must unite with engineers in other branches of the profession so that he can fulfill his obligations to mankind, and finally reach the professional and ethical status he has long sought.

The demand for EJC Affiliate membership came from groups of engineers throughout the country, meeting in the common interest of the profession. It was heard first nearly ten years ago, and was so insistent that EJC initiated the long series of studies by committees of council and finally by an Exploratory Group of delegated representatives of 15 national engineering societies. It was the long and arduous efforts of the Exploratory Group that provided the conclusions culminating in today's enlarged EJC.

During the lengthy deliberations of the Exploratory Group that led to the expansion of EJC, there persisted agitation for still another type of membership —individual membership. Much of this demand ignored the clear fact that the success, growth, and solidarity of EJC had derived almost entirely from representation by, and the continuing support of, the members of the boards of direction of its Constituent Societies. Such integration of Constituent Society policy and direction with the policy and administration of EJC has produced an overall solidarity of professional representation that has made possible EJC's many contributions to the nation's service. At the same time EJC has pursued its other equally important objective of developing our professional activity.

EJC's accomplishments frequently have required compromise, adjustment, and concession as between sister societies. It is essential in developing and maintaining professional solidarity that there be continuing compromise among its Constituent Societies, as I shall show.

For more than a quarter of a century after the formal organization of civilian engineering in North America, its national society, the American Society of Civil Engineers, represented the profession, all engineering then being classed as either civilian or military. Even a half century after the organization of ASCE, and after the mining engineers and the mechanical engineers had formed their own national societies, there was little, if any, demand for an overall representative organization. But with the rapid development of new branches of the profession (electrical, chemical, automotive, aeronautic, and now electronic and nuclear engineering), the practice of engineering became more complicated. Conflict developed on national and local issues because of opposing interests of corporate and individual practice.

Each such conflict weakened the entire profession, militated against acquisition of professional status, and decreased public respect for the profession. The great need for compromise and adjustment to permit a united front was recognized in the organization of EJC.

The earlier and now defunct American Engineering Council gave high promise of becoming the national coordinating society of the profession, but its organization included one fatal weakness. Although it was dependent for its financial support on the national societies, its administration soon became independent of national society control, approval, or veto. It acted on national issues on its own decision. Some such issues were of a nature where corporate engineering interests could not be reconciled with individual practice interests. Frequently decisions, made without reference to the AEC member societies, engendered opposition and resentment by one or more constituent society members.

EJC avoids this fatal organizational weakness. Its board of directors consists of appointees of the current sitting boards of its Constituent Society members, and such appointees not only report back to their respective boards, but on many issues approval by Constituent Society boards is essential to EJC action. No member society is committed to an EJC activity to which it has not initially subscribed. In some instances important matters under consideration may involve the interests of only a majority of Council members.

Initially EJC was organized as Engineers Joint Conference by the five national engineering societies. It set up a National Engineers Committee for study and report on the industrial disarmament of Germany and Japan, as the first of an imposing list of services in the nation's welfare. Later EJC forcefully presented the conclusions of a unified engineering profession on such matters as labor legislation, national water

policy, Army reorganization, engineering manpower, and the National Science Foundation. The success of its national presentations created a demand for similar opportunities for united action by engineers at the regional level. EJC was petitioned by federations of engineering societies, and by local or state societies and clubs, for assistance in organizing regional EJC's as chapters of the national organization. A committee of EJC was immediately formed to study and report on the entire complex subject of enlarging EJC nationally and regionally and of expanding it into an integrated national society comparable with the American Bar Association and the American Medical Association.

Because regional federations of engineers initiated the demand for EJC expansion as a national professional unity organization, there has developed, quite naturally, considerable impatience and feeling that EJC has been too slow in providing for Affiliate membership to take care of regional engineering groups. But as one who has worked on this subject continuously from its inception, may I urge your indulgence.

At first, making provision for Affiliate membership of regional engineering groups seemed easy and workable. However, as successive EJC committees explored the problem, it developed that to plant deep and lasting roots for the desired organization, it was necessary, first, to determine the extent to which EJC should be enlarged through the admission of additional national society membership. Second, should EJC ultimately become an organization consisting of national society memberships continuously representing the broad policy determinations of its constituent membership and responsive to their decision? Third, should the goal be a super society in which all engineers might have individual membership, in time becoming independent of control by and responsibility to the national societies of the several branches of engineering? Fourth, should EJC risk its existence for the nebulous goal of combining these diverse objectives?

Strange as it may seem, this fourth and last issue consumed more time than any other in arriving at a conclusion. The reason for conflict of opinion on this subject is easy to appreciate. The structural frameworks of our several national societies differ, one from another. ASCE includes in its activity the ethical and economic well-being of its membership on an equal basis with its interest in their technological development, while some other Constituent Societies confine their interests to the technical development of their members. It was the latter societies that demanded provision for individual membership in EJC to provide their members with opportunity to develop their professional status.

When the Exploratory Group brought in its report on which today's enlarged EJC is based, I first opposed individual membership, based on a conviction that only through EJC's continuing coordination with, and control by, the current boards of its Constituent Societies, could the risk of a break-up comparable to that of American Engineering Council be avoided. I felt that such individual membership as might be obtained would be overwhelmingly from the branches of engineering whose national societies denied their members the sort of wholesome professional development that is provided so well by ASCE.

Nevertheless, when one of our sister societies demanded that EJC permit individual membership as her price for continued cooperation with EJC, I urged ASCE's Board of Direction to approve, and it did. I am convinced that that willingness to meet the demand of a sister society for a basic revision in EJC's constitution (which appeared contrary to ASCE principles and interest), was a significant step in the sound development of EJC as the unity organization of our profession. Fortunately, the board of directors of the society which made the demand for individual membership reversed its position, and the issue is dead for the present.

EJC bylaws wisely classify affiliate membership in two categories, namely Society Affiliate and Federation Affiliate. To make provision for both types seemed a simple matter. But when we considered our rapidly growing profession on a national basis we saw many red flags to signal risk of future confusion unless all foreseeable problems of regional representation and responsibility were thoroughly explored in advance.

Consider, first, the established regional engineering societies, councils, and clubs. While many appear to contain the desired elements for immediate EJC affiliation, there are several situations where two or more such present groupings represent substantially the same geographical area and substantially similar professional and ethical objectives. Then there are situations where local councils are in varying stages of organization, many having been stimulated by the example of EJC. When should such groups be eligible for affiliation, and how can there be assurance against competing or badly overlapping situations?

Ideally, each region should resolve all such questions within itself, so that applications for affiliation will come to EJC with maximum assurance of stability and of harmony with the objectives of the parent organization. Because of the long-range importance of such matters, bylaw provisions for Society Affiliates are still in the serious study stage. Such bylaws may be expected in the very near future.

Fortunately for the immediate interest of most ASCE Local Sections, bylaw provisions for the admission of Federation Affiliates have been approved by the Board of Directors of EJC. ASCE headquarters has received many requests for information as to rules and conditions for EJC Affiliate membership of federations of engineering societies or sections. Interest in the early establishment of such regional federations as affiliates of EJC became so intense that the Board of Direction of ASCE, at its June meeting in St. Louis, appointed a committee to encourage and assist ASCE Local Societies in the formulation of regional engineering federations, organized so as to be eligible for EJC Affiliate membership. That committee, under the chairmanship of Director Lawrence A. Elsener of San Francisco, has declared its interest in providing such guidance and assistance. Since federations of engineering societies, particularly of local sections of the national societies of engineers, will provide the ideal type of overall professional engineer representation, such groups should pose no problem of jurisdictional overlapping or of competitive effort.

ASCE believes that in their respective regions Affiliate societies must emulate the parent EJC in providing in their region the type of service EJC was created to provide nationally and internationally. They must make the many compromises necessary to present a united front for the profession. They must adjust to the organic differences between ASCE's broad scope of objectives, covering both technological and professional activity and growth, and those of some of our sister societies that may be much more restricted. They must maintain a broad ethical professional attitude of united action with the other branches of the profession.

In today's engineering era, when at long last the contribution of the engineer to progress has received public recognition, we must accept the God-given trusteeship of our profession if we are to continue to meet the full implications of the earliest and still best definition of the engineer—he who "directs the great sources of power in Nature for the use and convenience of man."

Engineers Joint Council, at national and regional levels, provides by far the most effective means so far developed, through which the profession as a whole can exercise its trusteeship, now so important to our national welfare.

(This address by Mr. Proctor was presented before the Professional Cooperation Luncheon at the ASCE Annual Convention.)

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St. Lawrence Power Project under construction

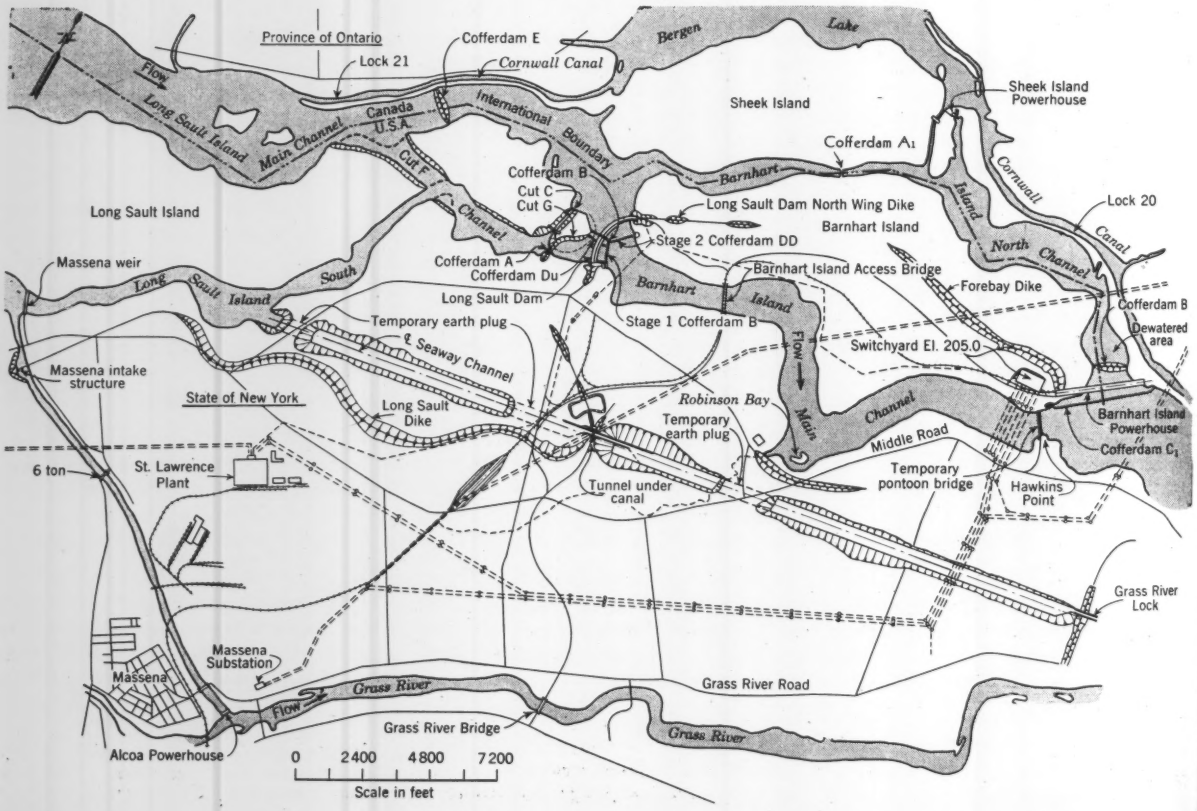
The St. Lawrence River Power Project, having an installed capacity of about 2,500,000 hp, is being constructed as a joint venture by the New York State Power Authority and the Ontario Hydro-Electric Power Commission. It is a completely separate undertaking from the St. Lawrence Seaway, based on separate authorizations, built by separate entities, and separately financed. The two projects are nevertheless closely related, and joint use of the river requires that they be completely coordinated in planning and operation. See "St. Lawrence Seaway and Power Projects Started," by Emerson C. Itschner, M. ASCE (CIVIL ENGINEERING, November 1954, p. 33).

The estimated cost of the power project is about $560,000,000, of which the share of the Authority has been raised by the sale of $335,000,000 of revenue bonds to prudent investors.

The power project is located in the International Rapids section (Fig. 1), where the river drops about 92 ft in less than 50 miles. Because of the enormous storage capacity of the Great Lakes, the flow of the river is remarkably uniform. Over the 90-year period of record, the historical mean is 236,000 cfs. The maximum monthly mean flow is 314,000 cfs, and the minimum monthly mean flow, 144,000 cfs.

At the project site the characteristic bedrock is dolomite interbedded with thin strata of shale, sandstone, limestone, and gypsum. Excavation now in progress shows the rock to be entirely

FIG. 1. International Rapids section includes main features of St. Lawrence Power Project, except for Iroquois Dam, control structure about 30 miles upstream of Long Sault Dam.



adequate to sustain the superimposed structures, although some grouting will be required to seal underground channels formed by dissolving gypsum. Beneath the upper dolomite layer at the Long Sault Dam is a layer of slate-like shale about 4 ft thick, but this formation, when preserved in its natural wet condition, is equivalent in every respect to the underlying and superimposed strata.

Major project features comprise Barnhart Island Power Plant, Long Sault Dam, Iroquois Dam, the Massena Intake, channel improvements involving about 66 million cu yd of excavation, and embankment containing 10 million cu yd of fill.

Barnhart Island Powerhouse

Largest single feature of the project is the Barnhart Island Powerhouse (Fig. 2). In conjunction with Long Sault Dam and the attached dikes, it controls all channels of the St. Lawrence River in the vicinity of Barnhart Island and creates the pool for the development of power and the improvement of navigation in the International Rapids section. The total installation contains 32 generating units with a combined rated capacity of 1,824,000 kilowatts (kw).

With the operating level at El. 242 ft, and with appropriate forebay regulation, the dependable capacity of the New York half of the power station will be 700,000 kw initially with 240,000 kw of secondary power. In later years, as the project moves into a more favorable position higher up on the load curve, it is anticipated that the firm capacity will approach the entire installed capacity. The total average energy output of the New York half of the power station will be 6.5 billion kwhr. Initially this output will comprise 5.2 billion kwhr of prime energy and 1.3 billion kwhr of additional secondary energy.

The powerhouse is a modified outdoor type in which elimination of the conventional superstructure affords an economy of about 7 million dollars. All repairs to the generating units, except those requiring removal of the rotating elements, will be possible within the unit housing. For major repairs, rolling hatches in the deck above each generator will permit the removal of any part of the unit by an outside gantry crane of 300-ton capacity which can traverse the length of the powerhouse. The traveling crane will carry a heated housing of sufficient capacity to enclose the part during its removal from the unit and during its transportation to the maintenance bays. These bays will be enclosed by appropriate superstructures, of sufficient size to admit the gantry. Thus both major and minor repairs can be carried out with full shielding from the weather.

The powerhouse is a massive reinforced-concrete structure in which the combined mass of the intake and generating unit substructure is utilized to sustain the reservoir overturning load. The coordinated design of the intakes, with the scroll cases and draft tubes, provides massive piers between adjacent units, which extend through the powerhouse from forebay to tailrace, carrying the reservoir load to the foundation rock in a straight unbroken line at right angles to the longitudinal centerline of the powerhouse. The heavy roof of the intake and scroll case serves as a horizontal girder acting as the upper support for the intermediate intake piers. To meet the requirements of the construction progress schedule, the intake alone is separately stable for the condition of reservoir at El. 235.0.

Intake gates are provided for each turbine and are operated by means of individual fixed hoists. The gates are equipped with overhung, double-flanged, roller-bearing, wrought-steel car wheels 24 in. in diameter, mounted on forged-steel cantilever axles that extend through the end girders of the structural steel framing. The wheels bear on 175-lb Lorain-type crane rails mounted on the downstream side of the gate slot. The rails are mounted on structural steel support towers embedded in the concrete of the intake piers to assure proper alignment. Sectional steel stoplogs and separate slots are provided to effect emergency closure. For handling the intake gates after their removal from the gate slots, and for

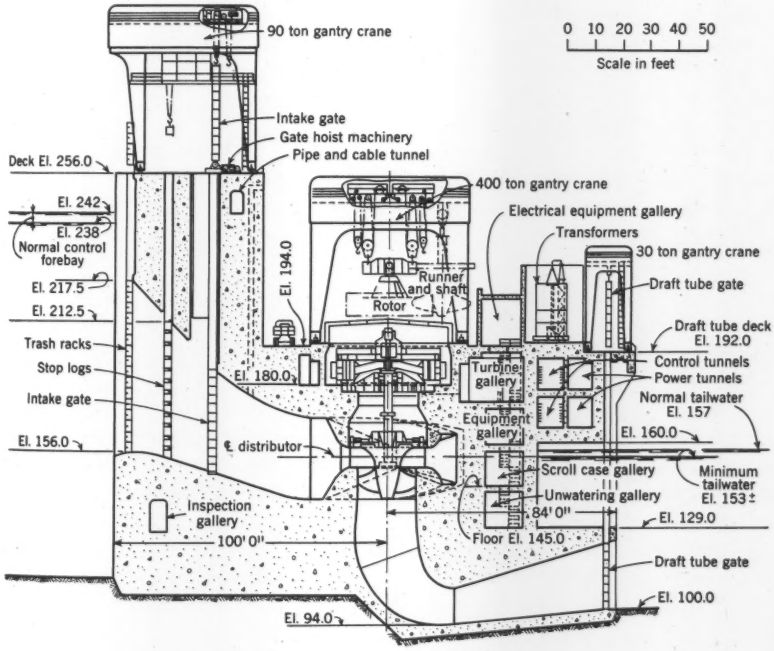
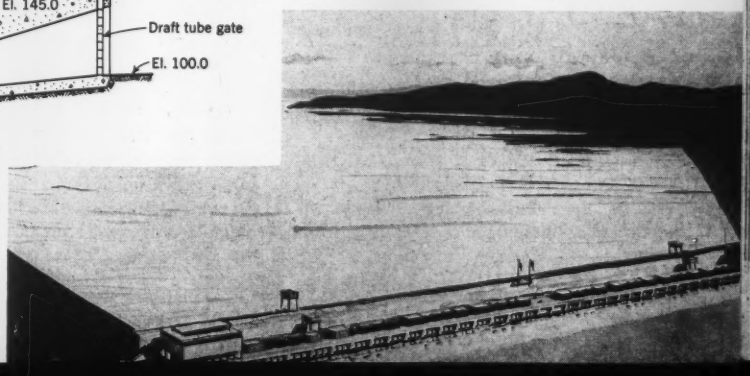


FIG. 2. Barnhart Island Powerhouse is core of the Power Project, being built jointly by New York State Power Authority and Ontario Hydro-Electric Power Commission. Sketch shows general arrangement of modified outdoor-type powerhouse and dam. Cross section indicates design of individual unit.



handling stoplogs, trashrack sections and other miscellaneous equipment, two 90-ton electric traveling gantry cranes are provided.

The hydraulic turbines will be of the vertical-shaft type with fixed-blade, propeller runners. The design capacity of each turbine has been established as 71,000 hp at the point of best efficiency, when operating under a net effective head of 81 ft, this being the head at which the units will operate the greater part of that time during which the plant output is near minimum capability. See Figs. 3 and 4. The normal synchronous speed at which the units will operate is 94.7 rpm. The ultimate operating head will vary from 77.0 ft to 87.9 ft, and the maximum

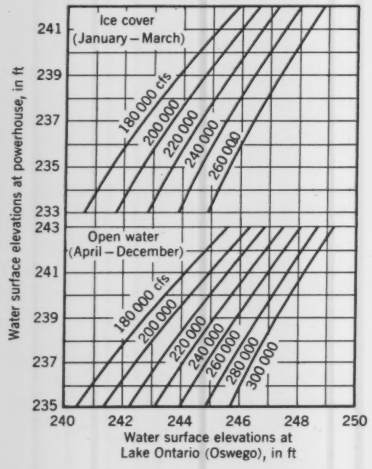


FIG. 3. Relations between water-surface elevations in Lake Ontario and Barnhart Island Powerhouse forebay are plotted. Iroquois Dam will control elevation of Lake Ontario.

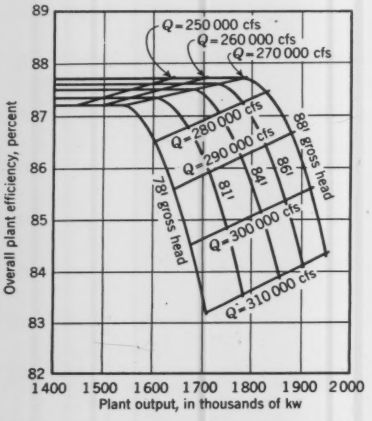


FIG. 4. Overall plant efficiency is plotted against plant output, in thousands of kilowatts.

capacity at full gate with the latter head will be 88,000 hp. Draft at best gate and 81-ft head will be about 8,400 cfs, and maximum draft at this head will be 9,800 cfs. The runners, of cast steel, will have a diameter of about 242 in. The main turbine shafts will be 36 to 38 in. in diameter, of forged steel, heat treated, with suitable integrally-forged, flanged couplings for connection to the generator shafts and runner hubs. The turbine guide bearings will be of the oil-lubricated type.

Rated 60,000 kva, 57,000 kw at 95-percent power factor, the generators are capable of carrying continuously a 15-percent overload or 65,500 kw at 95-percent power factor. They are of the umbrella type with a combined guide and spring thrust-bearing below the rotor. No upper guide bearing is provided. The thrust flange is forged integrally with the generator shaft.

A concentration of power, such as that in the St. Lawrence Project, requires immediate transformation to high voltage to avoid costly low-voltage conduction and regulation problems. Consequently, the main stepup transformers will be located near the generators on the downstream platform above the draft tubes at El. 196. The step-up voltage selected for local transmission is 115 kv; for the more remote loads the voltage selected is 230 kv.

A distinctive feature of the electrical design is the elimination of overhead transmission structures on the powerhouse, made possible by installing 230-kv and 115-kv high-pressure cables of oil-pipe type, from the transformer banks to the switchyard. For this particular project, the superiority of cables from the standpoint of trim appearance, low maintenance, and reliability was found to outweigh any slight adverse differential in cost.

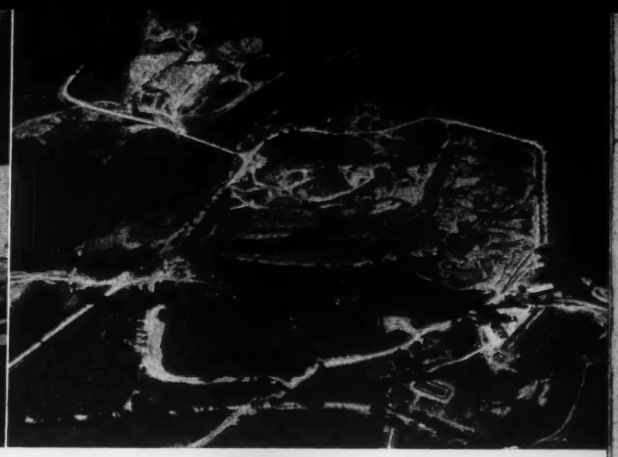
Long Sault Dam

A conventional gated ogee spillway, the Long Sault Dam is curved in plan to conform with the natural location of the most favorable bedrock foundation for both dam and cofferdam (Fig. 5). The criterion for the gate capacity selected (30 openings 50 ft wide with crest at El. 217) is the ability to pass the maximum January flow (220,000 cfs) at the minimum pool elevation, El. 231. Eighteen of the gates, in the center of the spillway and opposite the deepest part of the river channel, are divided horizontally into two sections so that floe ice can be skimmed with lower gate-section crests at Els. 229, 232, and 234. These 18 gates will have fixed individual hoists. The remaining 12 gates will be operated by either of two 275-ton traveling gantry cranes on the deck. Because of the severe ice conditions encountered here in winter, special attention has been given to the question of keeping the gates and guides free of ice at all times. An air-bubbler system and adequate electric-heater elements will be provided for all guides. Sectional gates will also have heaters.

To meet the requirements of the river diversion program, Long Sault Dam will be constructed in four stages as shown in Figs. 1 and 5. Diversion of the St. Lawrence River during construction of this dam is particularly difficult not only because of the large steady flow, but also because three channels are involved—the Barnhart Island North Channel and the Long Sault North and South Channels. The Barnhart Island Channel is closed for the entire construction period by Cofferdams A-1 and C-1; the powerhouse is not required to accommodate any flow during diversion. Construction of Long Sault Dam across the two remaining channels is to be done in four stages.

During Stage 1, with the existing Massena rock-fill weir in place across the South Channel, with Cofferdams A and B in place for the Long Sault Dam, and Cofferdam A-1 in place for the Barnhart Island Powerhouse, Cut C with bridge piers will be open, so as to divert flow from the South to the North Channel, bypassing the dewatered area where the first $14\frac{1}{2}$ bays of the Long Sault Dam are being constructed. The ogee portions will be omitted in the first 13 bays, and the gates in the temporary low position will serve as diversion sluices during the second stage.

In the transition from Stage 1 to Stage 2, with the removal of all but the upstream plug of Cut F, and with all river improvements made in the South Channel, Cofferdams A and B will be removed, and the head across the plug in Cut F will be balanced by appropriate manipulation of the sluice gates in the 13 diversion bays of the dam previously mentioned. The plug in Cut F will then be removed and Cofferdam E deposited in horizontal layers while the 13 diversion sluices are operated to maintain natural river levels at Lock 21. During this time the wet excavation at the head of Cut F will be carried out, the plug will be placed in Cut C, and if river flows exceed normal, the existing Massena rock-fill weir will be removed. When Cofferdam E is completed, Cofferdam DD will be placed downstream of the dam, so that the area can be dewatered for Stage 2 construction of the remaining $15\frac{1}{2}$ bays of the Long Sault Dam. These $15\frac{1}{2}$ bays, together with $1\frac{1}{2}$ bays constructed in Stage 1, will contain 34 temporary tunnel ports through the ogee sections, equipped with temporary fixed-roller gates (Fig. 5).



Photo, top left:
Cofferdam for Barnhart Island Powerhouse is seen in May 1955, before unwatering, and before placing of temporary bridge between Hawkins Point (top left) and Barnhart Island (top right). (This bridge is described in Mr. Praeger's article, page 53.)

Photo, top right:
Long Sault Dam construction, first stage, goes forward behind Cofferdam A at left and Cofferdam B (bent cofferdam) at right. During this stage, flow is diverted through bridged Cut C to left of center. When completed, dam will close channel at right. See Fig. 1.

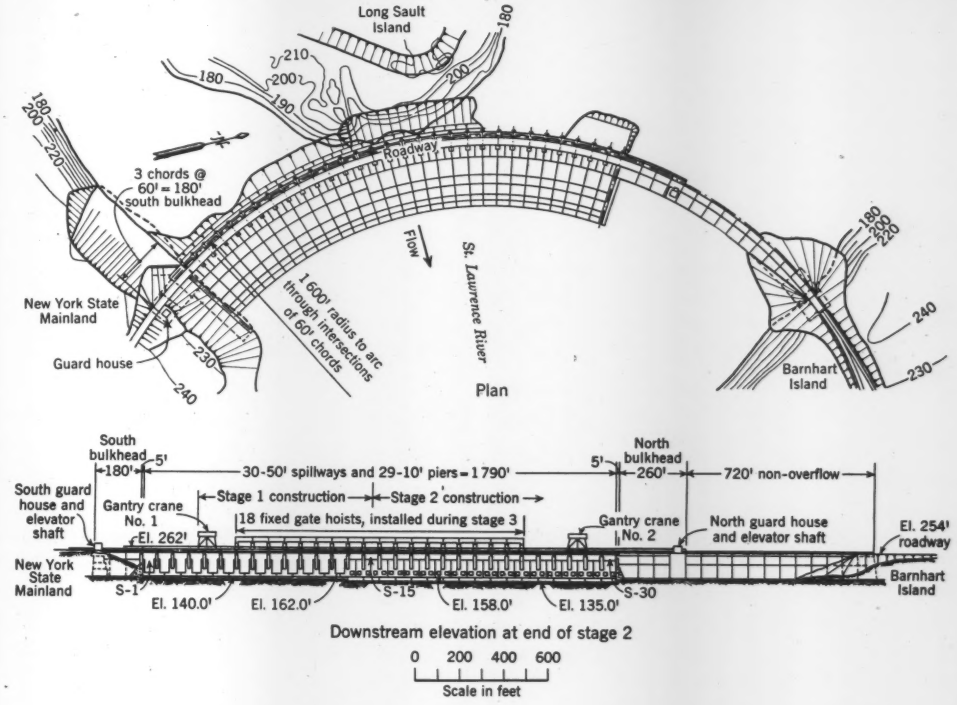
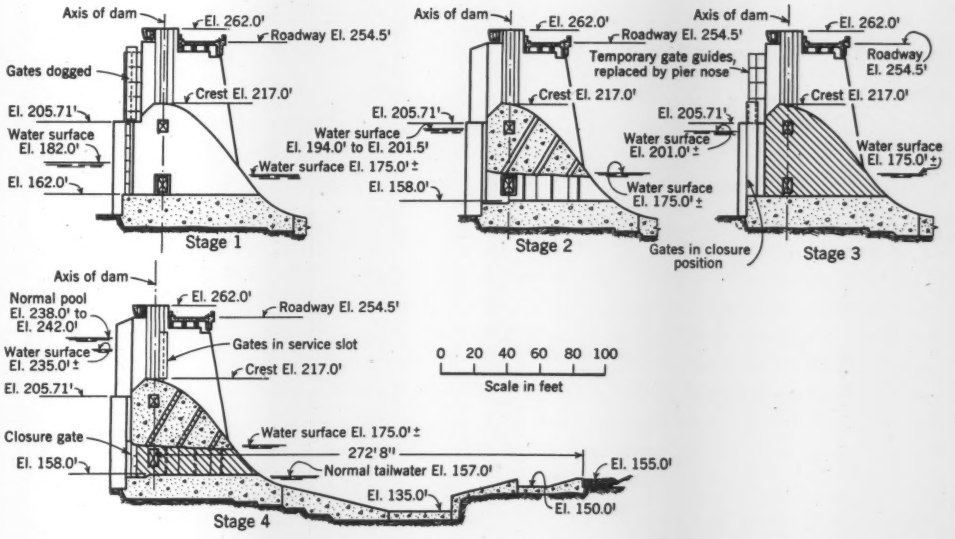


FIG. 5. Long Sault Dam—seen in plan, elevation, and cross sections—will be constructed in stages, as indicated.



At the start of Stage 3, the temporary sluice gates in the first 13 bays of the dam will be open and passing the river flow, while all 34 tunnel port gates in the second 17 bays of the dam will be closed. First Cofferdam DD will be removed and Cofferdam E breached, in order to balance the head across the plug in Cut C. Under balanced head the plug in Cut C will be removed and Cofferdam Du also will be removed. The diversion sluices in the first 13 bays of the dam will then be closed while the tunnel ports in the second 17 bays are being opened so as to maintain natural river levels at Lock 21, until all 13 diversion sluices are closed and the river flow is being passed through the 34 tunnel ports with the head pond at a level of approximately El. 201 at the Long Sault Dam. The ogee spillways in the first 13 bays will then be poured to completion with the head pond continuing at El. 201 (Fig. 5).

On completion of the ogee spillways in the first 13 bays, the 34 tunnel port gates in the remaining 17 bays will be closed progressively to raise the head pond while minimum river flow is passed through the tunnel port gates to the power plants downstream. When the head pond reaches El. 235, all tunnel ports will be closed and the river flow passed over some of the completed spillway crests while the tunnel ports in the second 17 bays of the dam are concreted to completion (Fig. 5).

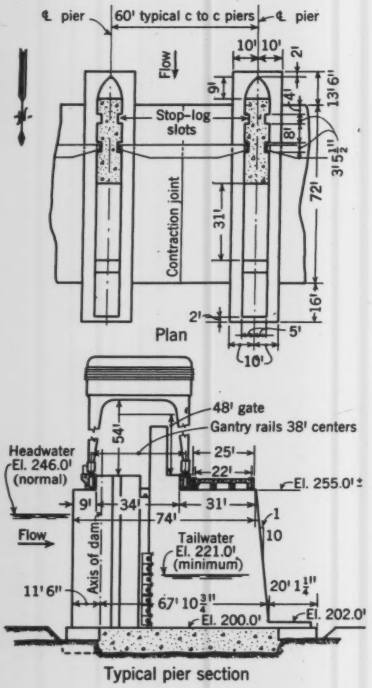


FIG. 6. Typical pier plan and cross section show design of Iroquois Dam, regulating structure on St. Lawrence River, 30 miles above Long Sault Dam.

Iroquois Dam

The Iroquois Dam is a buttressed gravity structure consisting principally of a series of piers and sluiceways. The 32 openings between piers are controlled by 32 fixed-roller, vertical-lift gates operated by two 350-ton traveling gantry cranes.

The function of the Iroquois Dam is to control and regulate the flow, replacing the control provided by the natural rock ledge that existed near Galop's Island upstream from the dam, which had to be removed to provide the requisite channel for navigation. This dam is necessary to regulate the outflow from Lake Ontario, and restrict to the practicable minimum any variations in lake level that would adversely affect the tremendous investment in physical properties along the lake shore. It will also dampen seiches on Lake Ontario due to barometric changes, and expedite formation of a very desirable solid ice sheet on the upper river.

From the standpoint of power-plant operation, Iroquois Dam will permit the essential variations in daily pondage without inducing corresponding variations in the level of Lake Ontario. In the event of any major damage to Long Sault Dam or the Barnhart Island Power Plant (by bombing for example), Iroquois Dam would furnish an important second line of defense against the draining of Lake Ontario, from which the natural rock-ledge control will have been removed. The gates of the dam will normally be fully open and the hydraulic head loss through the structure will be only about 0.2 to 0.3 ft.

Construction of Iroquois Dam will be accomplished by means of a conventional two-stage cofferdam. Aside from the large river flow to be accommodated continuously, and because each half of the structure is a fully gated waterway (Fig. 6), the diversion problem is relatively simple in comparison with that at Long Sault Dam. Completion of Iroquois Dam is scheduled so as to have its gated spillway available for the control of Lake Ontario levels before the natural control weir in the river at Galop's Island is removed.

Massena Intake

The Massena Intake structure will regulate the flow of water into the Massena power canal during and after the construction period. It will permit operation of the hydro power plant of the Aluminum Company of America until power is available from the Barnhart Island Powerhouse, scheduled for September 1958. It will also permit continuation of a domestic and industrial water supply to the village of Massena and to the Aluminum Company plants during and after the project construction period. The intake structure is of massive reinforced-concrete construction, equipped with a battery of fixed-roller gates, operated by individual electric-motor-driven hoists. Incorporated in the intake structure will be a pumping plant for the potable and industrial water supply. This plant will consist of five 10,000-gpm pumps capable of supplying water to elevated tanks on the property of the Aluminum Company under a head of 250 ft.

Dikes or embankments

The pool behind Long Sault Dam and the Barnhart Island Powerhouse will rise to elevations higher than much of the surrounding area. To confine this pool and to prevent outflow to contiguous drainage areas, a system of earth embankments will be constructed. These dikes, totaling about 14 miles in length, will have a maximum height of approximately 40 ft, and will include about 10,000,000 cu yd of compacted embankment, protected by some 100,000 cu yd of rock riprap on the reservoir side.

Embankments will be constructed of earth materials, consisting mainly of glacial till obtained from areas adjacent to the dike sites. The dike sections will generally be modified zoned sections with impervious glacial-till cores, supported by similar material compacted to a lesser extent and containing larger stones and boulders. Sand-and-gravel and rock sections will be provided in the downstream part of the embankments, to facilitate drainage and insure stability. Upstream slopes will be protected by heavy riprap placed on a filter blanket of sand and gravel; downstream slopes will be seeded to grass.

Compact glacial till, which covers much of the area where the dikes will be built, forms an excellent foundation material. There are, however, some areas underlain by soft marine clay deposits, and in such locations the alignment of the embankments will be changed wherever practicable to reach typical firm ground.

Channel improvements

Channel excavation to be undertaken as a part of the project will be of particular value to navigation by providing depth and restricting the velocity of the water. The channel work will also conserve power head and facilitate operation of the power project during the winter by limiting stream velocities so

(*Continued on page 110*)

Temporary steel-truss suspension structure avoids loss of 1955 construction season to builders of St. Lawrence Power Project

UNIQUE FLOATING BRIDGE

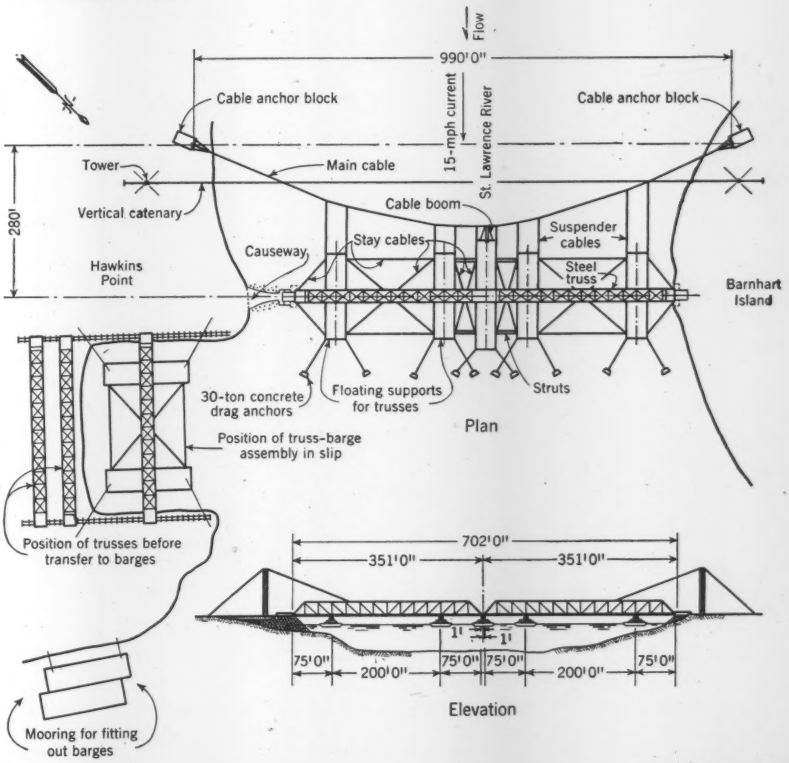
gives access to Barnhart Island

RICHARD Q. PRAEGER, J.M. ASCE, Partner, Praeger-Kavanagh, Engineers, New York, N.Y.
SIDNEY M. JOHNSON, Project Engineer, Praeger-Kavanagh

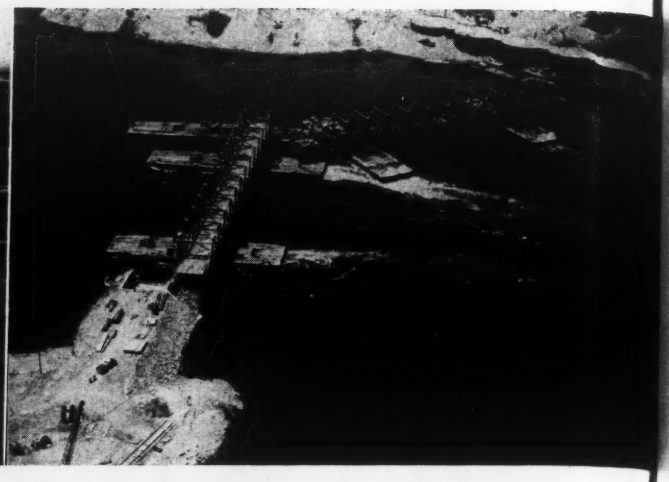
The unique floating bridge across the St. Lawrence River between Hawkins Point and Barnhart Island, New York, was officially opened to traffic on June 22, 1955, by Governor Averell Harriman and Commissioner Robert Moses. This event marked completion of the first major contract in the $600,000,000 St. Lawrence River Power Project, jointly sponsored by the Power Authority of the State of New York and the Hydro-Electric Power Commission of Ontario. This bridge provides the only access from the New York side to the powerhouse, dam, and other construction sites on Barnhart Island.

Known as the Hawkins Point Bridge, the $1,200,000 temporary span employs a unique type of construction. Essentially the structure is a floating horizontal suspension bridge. It consists of a horizontal main cable from which are suspended two steel truss spans, each 350 ft long (Fig. 1). Each truss is mounted on two steel carfloats, spaced to provide a 200-ft center span flanked by two 75-ft contilever ends. The carfloats are connected to the main cable by $1^5/_8$-in. wire-rope suspenders. The main cable, which comprises three parallel strands of $2^3/_4$-in. prestretched bridge rope, is anchored to concrete deadmen embedded in each bank of the river. The bridge was completed in less than a year—from authorization, through

FIG. 1. Steel-truss suspension bridge rests on reinforced-concrete abutments and floating barges supported by horizontal cable which maintains alignment against swift current of St. Lawrence River.



Trusses, erected on blocking on Hawkins Point, were rolled down to the river and on to barges on railroad car trucks and track. Spring thaw hampered operations for several weeks.



Two sections of bridge were swung into place separately, then pinned together. Second section is here being pulled into position by cables attached to main cable and to deadman on island. At upper right

design to completion—despite an extremely severe winter and a spring thaw which stopped almost all construction work in the area.

In June 1954, the Power Authority of the State of New York received the first funds for engineering and construction costs required for installation of its huge power project on the St. Lawrence River, west of Lake St. Francis near the cities of Massena, N.Y., and Cornwall, Ontario. Early in the preliminary planning and scheduling stages of the development program it was realized that completion of the $70,000,000 Barnhart Island Powerhouse, one of the key elements in the project, and of several other nearby and related structures, would be seriously impeded unless access could be provided to Barnhart Island from the New York mainland by late spring of 1955 and continuously maintained for approximately five years, that is, until construction work could be completed on the Long Sault Dam.

Because of the varieties, quantities, and huge size of much of the materials and equipment required for the several installations on Barnhart Island, it was decided to construct a bridge providing facilities for railroad as well as highway traffic. The site selected for this span is just south of the Long Sault Rapids, where the river is confined between relatively high banks, thus providing the necessary under-clearance with a minimum amount of approach work. Preliminary studies indicated that a continuous steel-truss structure having an overall length of 1,073 ft and a center span of 508 ft would be most suitable for the crossing, and the design was begun immediately. It was, however, obvious from the start that the design and construction of this type of bridge could not be completed, even under ideal conditions, before the early winter of 1955. Some other temporary crossing would therefore be essential if a full summer of construction work was not to be lost. Inability to cross the river during the 1955 construction season would result in loss of interest on the investment and loss of income from the sale of power for an entire year, a total of many millions of dollars.

Faced by this unusually limited time schedule, the engineers discussed many proposals for providing and maintaining access to the island during 1955, and until such time as the long, permanent span could be completed, at which time the temporary structure would be removed. These proposals included a ferry, a monorail conveyor, a trestle bent structure, and the use of piers formed from Delong Docks supporting steel trusses.

Some of the schemes, such as the ferry and the conveyor system, were rejected as inadequate for the sizes and amounts of materials and equipment to be transported. (For example, a request has recently been received and granted to permit an 85-ton shovel to cross the bridge.) Structures requiring the use of piles were considered unsuitable because the river bottom, as a result of scour from the 15-mile-per-hour current, is almost devoid of overburden, and the exposed rock is so hard that piles cannot be anchored against the horizontal forces resulting from wind and water. The current is so swift that borings had to be abandoned after only two holes were drilled because the boring rig could not be adequately anchored. It was felt that floating construction equipment could not be used without the provision of a sizable cable and deadman anchorage system.

These considerations led to the decision to use a prefabricated floating bridge. Several types were studied, including precast concrete barges strung in an arch form against the current. The present design evolved from one accepted by the Power Authority, in which a series of short-span trusses were to be supported on Navy pontoon sections and the whole suspended from a cable system, similar to the type of construction used by the Army for assault bridges. The final design, employing carfloats, is superior because the forces of the current are reduced and the bridge has a more stable horizontal alignment.

The bridge was designed for maximum ease and speed in fabrication and erection. The trusses are composed of rolled shapes connected with high tensile bolts, and the deck is of timber spiked to nailing strips which in turn are bolted to the top flanges of the steel stringers. The top- and bottom-chord lateral bracing systems of the truss spans act as the stiffening trusses for the main cable.

The carfloats that support the steel trusses were purchased in New York City and were cut into sections of the required area, strengthened, fitted out, bulkheaded, and modified as required in the New York shipyard of the Bethlehem Steel Company. These floats are constructed with tapered, raked ends which provide adequate streamlining for the water velocities encountered at the site.

note cells for Cofferdam C-1, behind which Barnhart Island Powerhouse will be erected. Main three-part cable for bridge runs from anchorage on Barnhart Island (foreground in photo above) to that on Hawkins Point. Supporting cables are connected to guyed towers.

Box-type abutments confine ends of bridge, permitting movement and rotation of truss spans while providing reaction points for longitudinal and unbalanced wind forces.

After the carfloats had been fitted out, in the summer of 1954, they were towed up the Hudson River to Albany, from Albany to Oswego via the New York State Barge Canal, and thence to the site via the St. Lawrence River and the Cornwall Canal. Considerable difficulty was experienced in moving the barges from Cornwall to the site, because it was necessary to tow them upstream in the open river against strong, shifting currents. This was accomplished, however, and the floats were anchored for the winter in a sheltered cove a short distance downstream from the bridge site.

During the winter of 1954-1955, the approach causeway from the New York side was placed and the concrete abutments at the ends of the bridge and the anchorages for the main cable were constructed by the substructure contractor. During this period, the superstructure contractor dug a shallow slip in the river bank on the New York side just downstream from, and sheltered by, the causeway. The two truss spans were then assembled on blocking placed adjacent to the slip and parallel to the river. Next, two lines of railroad track were laid, extending from under the cantilever ends of the truss spans down to the shore.

Just before the spring thaw, two guyed steel towers, 85 ft and 100 ft high respectively, were erected, one on each bank of the river. Cables strung from these towers support the main cable by means of two suspenders so as to keep the main cable from dragging on the river surface. The use of these towers and cables facilitated the placing of the main cable and will make the removal of the bridge, which is included in the superstructure contract, less difficult.

After the breakup of the ice jam, which occurred about January 13, 1955, the main cable was pulled across the river from the vertical catenary, attached to the anchorages, and held clear of the water by suspenders attached to the messenger cable.

One barge was then suspended from the center of the main cable (See Fig. 1). The purpose of this center barge or carfloat is to provide support for the trusses in case a carfloat on either side of it becomes submerged. Suitable shoes are provided at the truss ends for this purpose on the center barge, which is equipped with a grillage and heavy bearing plates. A similar arrangement is available at the shore ends of the trusses, with bearing plates in the abutments. After the center barge was set, two carfloats were moved into the slip and one of the trusses was jacked up and placed on small railroad-car trucks. The truss was then moved on the tracks previously placed to a position over the floats and lowered onto the grillages by means of jacks. After attaching the necessary stay cables, heavy lines were run from temporary clamps on the main cable to 100-ton winches mounted forward on each float. Several additional lines were then run to other winches and to deadmen on shore and to sea anchors placed in the river. These lines served to steady and align the assembly while it was being swung into place.

After all the anchor lines, stay cables, and winch lines were ready, the director of the erection operation transmitted his orders by means of signal flags and a bullhorn to subordinates stationed at the several winches and anchor points, and to personnel aboard two tugs and several small river craft, and the truss-barge assembly was eased out of the slip into fast water. Despite the presence of strong, shifting currents at the site, the assembly was slowly moved out into the stream with the truss span parallel to the shore. It was then carefully pivoted so that the truss was perpendicular to the shore and moved upstream to a position just northeast (downstream) of its final location.

This operation was repeated for the second truss span. Then the two spans were jockeyed into final position and pinned together. The timber deck was spiked to nailing strips previously bolted to the top flanges of the stringers. Hinged ramps, which compensate for variations in water level in the river, were erected from the bridge ends to the abutments. Finally, the main cable and the suspenders were readjusted, and the bridge put into operation.

The design and field supervision of the floating bridge was executed by Praeger-Kavanagh, Engineers, New York, for the Power Authority of the State of New York, for which W. S. Chapin is General Manager, and J. Burch McMorran, M. ASCE, Chief Engineer. The substructure was constructed by the A. S. Wikstrom Co. of Skaneateles, N. Y., and the superstructure by the Walsh Construction Co. of New York, N. Y.

The paradox of professionalism in

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The growing belief—almost to the point of general acceptance—that programs of engineering education should center on what is called "the education of professional engineers" as contrasted with "the training of vocational specialists" gives rise to a number of questions. Not the least of these is the meaning of the term "professional." The word has a happy ring; like virtue, it can scarcely be opposed. Yet it denotes a concept that means many things to many people. While the writer has thought about it a great deal, particularly as it relates to engineering—read about it, and talked about it to many people—he has yet to encounter or devise a brief, definitive statement that pin-points its meaning.

Services rather than things

Professionalism seems to imply dealing with services rather than things, and there is the further implication that a rather direct relationship exists between the professional man and the clientele he serves. His services should, apparently, be of a type such that their satisfactory performance depends in part on the mastery of an important and organized body of knowledge. However, it is usually recognized that mastery of knowledge, by itself, is not a sufficient base for professional operation and must be matched by a certain amount of experience in which some degree of successful responsibility is an indispensable element.

Another and an important aspect of professionalism appears to warrant special recognition. It has to do with an attitude toward life—toward the client, toward the profession, and toward the general public. In this attitude a balance is maintained between interest in the welfare of others and in mere self-gain, so that the former is in no danger of being submerged by the latter. This attitude finds expression in many ways such, for example, as in faithful service to clients, in participation in the work of professional societies, in creative work leading to professional publications, and in public services conducted without thought of direct self-benefit.

The fact that such an attitude is an important aspect of professionalism is worthy of emphasis but it is perhaps even more pertinent to inquire into the reason why the professional "attitude" is so indispensable to professional "practice." This springs, to an important degree, from the fact that professional services are of a type that cannot be completely defined or specified in advance of an undertaking, and must therefore depend in their performance on the integrity and ethical standards of the professional man. If these services were capable of complete specification, they could be treated as any other commodity on the market, and limited by legal considerations rather than by professional responsibility.

The various facets of professionalism may be a matter for some debate—not only as to which of them should be recognized, but as to the relative emphasis that should be given to each. Some might, for example, believe that a direct personal relationship between the professional man and his clients is an essential ingredient in professionalism; others, realizing that the trend today is toward large organizations in which many engineers rarely come in direct contact with the clients they serve, take the position that the personal nature of professionalism is not really of the essence.

The statement can scarcely be challenged that professional services, for their satisfactory performance, depend in part on the mastery of an important and organized body of knowledge. Indeed it is the very scope of this body of knowledge, together with the fact that it can be organized for purposes of education, that has led to the development of the professional school as we know it today. In engineering, mathematics and science (together with engineering science) are taken—and properly so—to be the core of this body of knowledge. They are the foundation on which engineering applications can be built; they are the so-called "fun-

damentals" of engineering. A mastery of these subjects is clearly essential to the professional engineer, and it has therefore seemed self-evident to many that as the engineering curriculum has leaned more and more in the direction of these "fundamentals," engineering education has thereby become more and more "professional" in character.

This kind of thinking can easily be extended to the point where some may believe that any branch of engineering not resting heavily on science—and preferably on advanced science—is of questionable professional stature. It may even be held that engineering not dependent on the extensive use of advanced science and mathematics is not creative in the true sense. The scientific aspects of engineering seem somehow to have grown in stature in recent years to the point where they are in danger of becoming synonymous with creative endeavor and with engineering achievement, and therefore with professional engineering. Because the mastery of a certain amount of science and mathematics is essential to the professional engineer, there has been a tendency to believe that the mastery of more science and more mathematics would automatically enhance the professional character of engineering education.

The point which seems to have been overlooked is that, since science deals in the main with systematized knowledge, an increasing emphasis on science, and on a wholly rational approach to things, steeps the mind of the student in the processes of exact reasoning, to the partial exclusion, and perhaps to the inhibition, of judgment, imagination, and intuition. Yet these are essential to successful work in the broader spheres that include, but lie in part beyond, the limits of systematized knowledge—spheres where things that are but partly systematized, or perhaps largely unsystematized, are encountered.

Services not clearly defined

If all knowledge could be systematized, it is possible that all engineering would be wholly rational. But all knowledge is not systematized—nor will it ever become so. The professional man must have a firm base of systematized knowledge, but in professional practice such knowledge is but a background for most of the situations he will encounter. It has been previously suggested that professional services are of a kind that cannot be clearly defined or specified in advance; in other words, the professional man must operate in areas that are in part above and beyond the well-documented but relatively limited areas of systematized knowledge. Perhaps the principal function of the truly professional man is to harmonize and relate the conflicting forces and tendencies that arise because of the very fact that the total systematizing of knowledge is an impossibility. Such a process of harmonizing and relating is not a science but an art. And if this art of engineering be obscured by science to the point where it is in danger of losing recognition, the very essence of professionalism may likewise be lost.

Nevertheless, the art aspect of engineering seems somehow to have fallen into ill repute; it has become associated in the minds of many with rule-of-thumb methods, with handbook engineering, and with the use of empirical methods when rational approaches might better be employed. Because certain phases of the art have been recognized as undesirable and subprofessional, there has been a definite tendency to conclude that all of the art of engineering is undesirable and subprofessional. Nothing, of course, could be farther from the truth. While the routine phases of either the art or the science of engineering are frequently subprofessional in character, the judgment and imagination involved in either one—and more likely to be demanded by the art—may well represent the highest form of professional expression. The betterment of our environment depends on what is done rather than on scientific complexity. Creativeness should be measured by its potential influence on human welfare rather than by emphasis on either science or art.

Both art and science needed

Herein then lies the paradox of professional education in engineering: that emphasis on the basic sciences and mathematics, though essential, tends to encourage systematized thinking and so to inhibit the development of judgment and imagination—qualities essential to the highest type of professionalism. If, in the name of professionalism, engineering education veers too far in the direction of science, that part of the art that exemplifies truly professional practice can be crowded out, thereby leading only to a high type of vocationalism—to scientific vocationalism. As soon as any area of knowledge becomes systematized it becomes largely subprofessional in character—however complex it may be, and however important as a partial basis for professional practice. If a thing is systematized, it can be mechanized; or, if mechanization should be found uneconomical, it can be highly organized for inexpensive and subprofessional operation.

Let us not, then, in our effort to raise the professional character of engineering education, mistake scientific content for professionalism, nor mathematical complexity for engineering achievement. Let us rather recognize that art as well as science is intrinsic in the profession of engineering, and strive for a balance between the two. Let us not pit the one against the other, but draw on the fullness that each can offer for our educational program.

This plea for a recognition of all that the art of engineering can offer to engineering education is in no sense a plea to weaken the role of science. Indeed it is the reverse of this, for only when science and art complement each other can science become truly effective in engineering. Then—and only then—can science support a structure that extends far beyond the relatively narrow confines of systematized knowledge, and into the greater realm of conflicting realities which is the true domain of professional engineering.

Design concepts change at

New York International Airport

JOHN M. KYLE, M. ASCE, Chief Engineer, The Port of New York Authority, New York, N.Y.

Never before in the history of a transportation medium has the opportunity been present, as it was at New York International Airport, for the development of an entire facility under one management with free rein given for the evolvement of sound economic and engineering concepts under a coordinated plan. This opportunity was presented to The Port of New York Authority when, in 1947, the City of New York entered into a 50-year lease with the Authority to develop New York International Airport, better known as Idlewild, as the outstanding air terminal of the world.

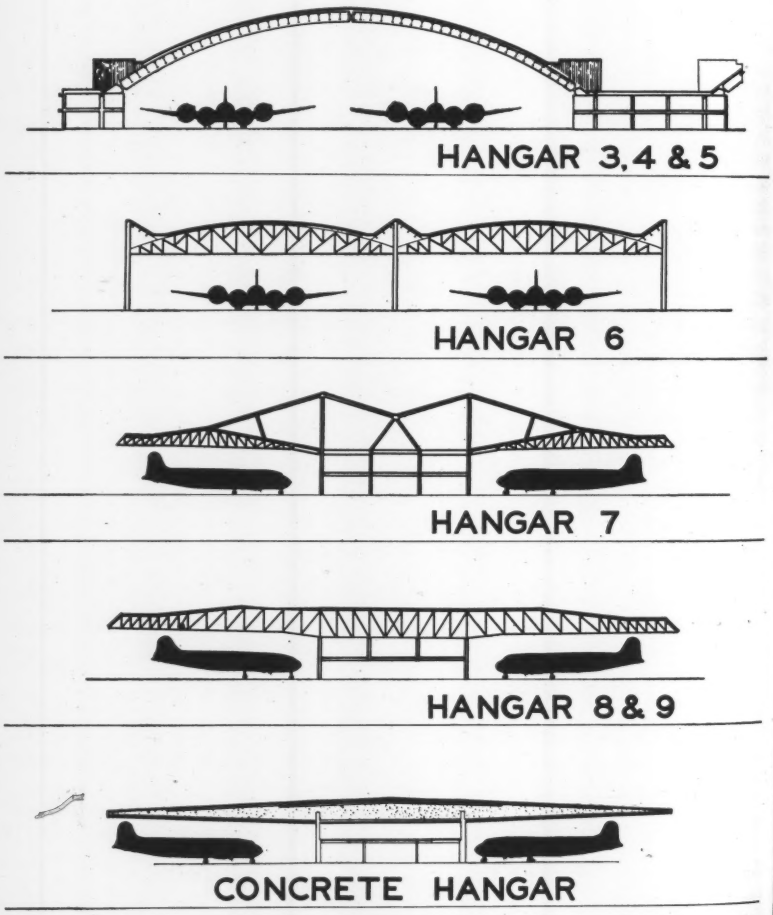
Prior to 1947 the city, realizing the importance of air commerce, had assembled this magnificent 5,000-acre site and had installed some of the basic utilities, but found that to continue the development of the field would badly tax its already strained finances. The Port Authority therefore contracted to go forward with the development, investing its own funds. In return the city receives a basic yearly rental, or three-quarters of the net income after payment of operating and financing expenses, whichever is greater.

Before proceeding with the development of the field, it was of course necessary to determine the maximum potential traffic that could be handled economically and efficiently at the site. Statistics were assembled and an analysis made of the total regional traffic. This in turn was broken down into that traffic which could be expected to utilize New York International Airport, largest of the four airports maintained by the Authority in the metropolitan area.

Using the technique which *Business Week* characterizes as "trend extrapolation," future traffic was forecast. On the basis of the traffic prognosis, master plans were developed for the four airports and layouts made for the logical development of various areas at New York International Airport. Early in the planning it was determined that the entire central area, consisting of 655 acres, would be devoted to the handling of passengers; and that the areas adjacent to the runways would be used as sites for the tremendous hangar development needed to support simultaneously the world's largest trans-Atlantic air service and a major portion of the domestic air traffic to and from New York City. Such peripheral areas as remained were to be used to supply much-needed industrial sites.

Although the studies for, and development of, adequate runways, taxiways, roads, sewers, and electrical and water distribution systems to serve an air base of this magnitude are interesting, this article will concentrate on the hangar and terminal development which has proceeded apace since the Port Authority first assumed responsibility for the airport.

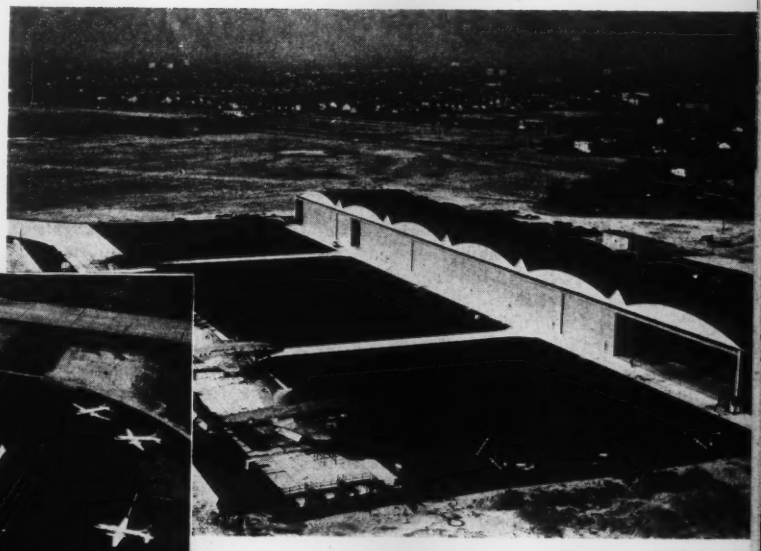
So far hangars have always been a problem of compromise. It is difficult to predict the ultimate wing size and



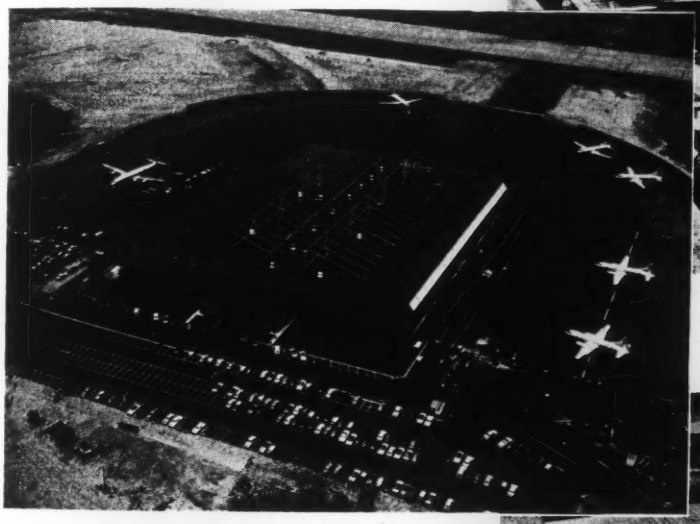
configuration, how high the tail will be or how heavy the plane will become. Thus the characteristics of the building required to house the plane are difficult to develop. Our first approach to major hangar design was to consult with the airlines and obtain their thinking on the ultimate plane development and the ideal building to accommodate this development. The result of these consultations was a prototype design for a 300-ft arch hangar with a clear height of 62 ft and a length of 218 ft. Originally this was conceived as a two-unit hangar with maintenance shops between and on each side of the units. Before construction actually began, the airlines requested the construction of a third unit, and so Hangars 3, 4 and 5, having three 300-ft bays and four lean-tos, were designed and built (Fig. 1).

Construction costs for these three hangars were such that all costs, when amortized on a 30-year basis, could be recovered by the Port Authority at a rental of $1.65 per sq ft for the hangar and $2.25 per sq ft for the lean-to.

Hangars 3, 4, and 5, 1950



Hangar 6, 1953



Hangar 7, 1954

Hangar 8, 1955

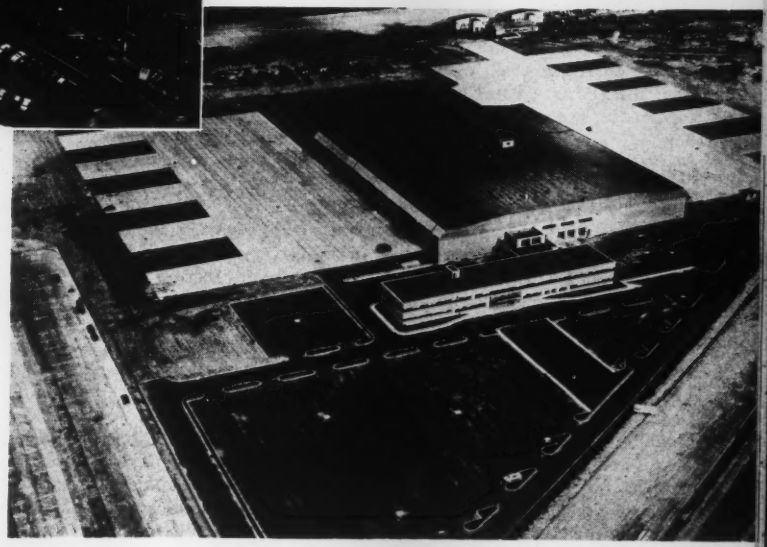


FIG. 1. Three main types of hangar have been designed and built at New York International Airport, better known as Idlewild. These are: (1) three-hinge steel arch supported by counterforts resting on spread footings, top sketch; (2) bowstring trusses, using king trusses for intermediate support, next to top; and (3) various cantilever designs, shown in three lower sketches. Bottom design has not been built, since in actual bidding, steel cantilever proved cheaper than concrete. Aerial photos on this page show completed hangars.

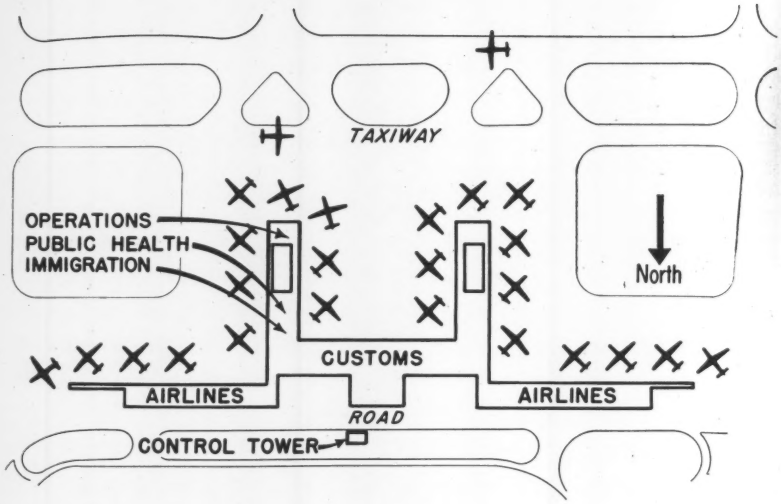
The structure consists of a three-hinge steel arch supported by counterforts resting on spread footings. The floor is concrete with radiant heating pipes imbedded in it. Walls are masonry, and the entire structure is protected by a deluge sprinkler system. Because of the maintenance activities to be carried on in these buildings, doors were provided on both sides. This allows any ship to be moved in or out without disturbing others on which work is progressing. A unique feature of these buildings is the boiler-room location. Because ground-floor space is at such a premium, it was found economical to locate the boilers on the third floor of the lean-to.

Although this type of hangar is still popular, we have since found that satisfactory results can be achieved at substantially lower costs. Studies devoted to developing a less expensive type of structure led to the bowstring design, using king trusses for intermediate support. This design was used for Hangar 6 (Fig. 1). The trusses are 140 ft on centers and give a clear height of 32 ft. This building uses pile-supported foundations. The lean-to area extends the full length of the 842-ft structure on the side away from the apron. Doors are on one side only. Planes are wheeled into docks located along the back wall of the hangar. In the interest of economy, radiant heating was omitted from the floor, and steam-fed blast heaters were installed.

Still seeking a less expensive solution, the Port Authority retained consultants to participate in a study of all possible types of hangar development. This study was conducted in an effort to develop comparative cost estimates on all known and, at that time, some unknown hangar configurations. It was our opinion that to achieve complete flexibility, a cantilever type of structure must be developed. This would eliminate the columns which limit plane size in Hangar 6, and allow for future lateral expansion. We also hoped it would reduce costs.

Inexpensive cantilever developed

After an analysis of all the designs suggested, it was apparent that an inexpensive cantilever for hangar roof construction had never previously been developed. Studies soon indicated that it was possible to design a structure having a center lean-to that could be used for shop and office space. Further analysis showed that a successful cantilever could be constructed in conventional steel, reinforced concrete, or prestressed concrete. Various forms and configurations of the steel trusses and concrete elements were developed. For each of the next three hangars constructed, an efficient and economical cantilever was engineered (Fig. 1).



In theory a prestressed concrete structure could be built to fit the space and structural requirements. By actual competitive bidding, however, it was established that, at least at that time, a steel structure was 8 percent less expensive for the same space and load conditions. The various forms assumed by this structure are shown in Fig. 1. The prices vary with the finish, lighting, and heating requirements of the tenant.

It is our opinion that, to be efficient and economical, the modern hangar must be expansible and must make provision for the larger planes of the future without any major modification of the basic structure. The cantilever satisfies all these requirements except in the case of ships with extremely high tails. In this case the hangar can be modified by the installation of a "dog house" between any two adjacent supporting roof trusses without affecting the rest of the structure.

Radiant heat is a very fine operational feature if it can be afforded. Such an installation raises the unit cost of the structure approximately 2.2 percent.

For fire control, a full deluge system is a "must" in any modern hangar. Costs vary according to conditions, from $1\frac{1}{2}$ to 4 percent of the total hangar cost. To make this system operationally feasible, it must be backed up by adequate water storage and pumping facilities. Experiments with many types of sprinkler control mechanisms indicate that the deficiencies in the old rate-of-rise control devices have been overcome and that control devices are now quick acting and dependable.

Because of the great flexibility of a cantilever hangar, it is possible to use large individually motorized doors deriving power from overhead rails. With this type of door, door pockets are superfluous. For safe operation the doors must, of course, be protected by safety devices which immobilize the mechanism when a man door is open, or when a main door comes up against any object in its path, be this object a person, a vehicle, a plane, or another door. It is surprising to what lengths mechanics will go to inactivate the safety devices. It taxes the ingenuity of even the best engineer to develop a completely foolproof mechanism. Such a device has been produced by at least three of the door manufacturers and is now available on the commercial market.

Adequate illumination at the working level is essential. The most economical and at the same time the most efficient type of lighting we have been able to develop is what is known as the slimline system, utilizing a 480-265-volt distribution. Employing industrial-type fixtures, an illumination of approximately 35 ft-candles at the working level has been achieved throughout the hangar.

Constantly rising construction costs and the demand of the airlines for finer and finer facilities are inspiring challenges to any engineer. Because we pioneered in this field of modern hangar development and have lived through the transition here described from three-hinge arch, to king-truss bowstring, to full double cantilever hangar, all at one general location under the same working and union conditions and with essentially the same type of foundation conditions, we have, I feel, been able to develop a reasonable yardstick for comparing values. Taking into consideration the

FIG. 2. Arrival Building for overseas passengers, as projected, has plan form of letter U. U. S. Customs will have space in base of U, and Wing Buildings will be for use of foreign-flag carriers. Parabola, seen in sketch above just to right of, and beyond Control Tower, is envisioned as gateway to United States for major air transfer of those entering from overseas. This steel structure, with span of 230 ft and clear height of 46 ft, will front on 570-ft mall, where incoming passengers leaving airport will board surface transportation media.

rising cost index, the relative costs of these structures are as follows:

Hangar Type	% of Base Price
Conventional 3-barrel steel arch hangar	100
6-barrel steel bowstring truss	63
Suspended cantilever with exposed steel	52
Double cantilever with roof above the steel:	
Minimum construction	57
Plush construction	68

To develop adequate plans for a traffic estimated to exceed 8,500,000 air passengers annually in 1965, it has been necessary to do a research job in air terminal analysis. You have probably seen some of the fine small buildings, at airports such as Fort Worth, which are beginning to dot the airways of the United States. When we come to the tremendous building necessary to accommodate traffic generated in large cities, no satisfactory prototype has appeared. All of us are familiar with the long walking distances built into such terminals as Chicago's Midway and our own Temporary Terminal Building at New York International Airport (which, of course, is necessarily bare minimum construction). Obviously, this could not be allowed in the new concept now on the drawing boards.

After prolonged soul searching, and contrary to our original preconceived thoughts, we in the Port Authority, and the distinguished consultants assembled to work with us on this project, came to the conclusion that it was not possible to serve the traveling public adequately in one building no matter how imaginatively executed or designed.

The major domestic airlines, facing the serious problem of reducing walking distances for their clients while still maintaining adequate apron space for the servicing of their planes, and the Port Authority agree that each airline should have a building of its own to serve arriving and departing passengers. Under this arrangement, the actual handling of passengers from limousine to ticket counter to plane, and on the return trip, from plane to baggage-claim area to limousine, will be completely controlled by the airline to which the passenger has paid his fare.

Because of the necessity for processing all incoming international passengers through a central immigration, public health, and customs routine, all trans-Atlantic carriers will share an International Arrival Building for the passengers arriving from overseas (Fig. 2).

The foreign-flag carriers, having a limited operation, will be able jointly to occupy two Airline Wing Buildings adjacent to this building. From their offices in these buildings they will be able to dispatch their overseas passengers directly or through corridors to outgoing planes. The two major American-flag overseas carriers, although using the International Arrival Building in common with the foreign-flag carriers, will each dispatch passengers from its own unit terminal.

Serious long-time planning in coordination with the architectural firm of Skidmore, Owings & Merrill and our consulting architect, Wallace K. Harrison, has served to finalize the plans for an Arrival Building of 526,317 sq ft (Fig. 2). This structure, shaped somewhat like the letter U, will be served by 24 gate positions. In the two uprights of the U will be the airlines' operating space and the passageways to and from the plane positions. At the base of the U will be 100,000 sq ft of government agency space.

This building will be connected by a short passageway to a parabolic structure which in years to come will serve as a major gateway to the United States for the vast majority of people entering America from overseas. This steel structure, having a span of 230 ft and a clear height of 46 ft, will front on a 570-ft mall, where arriving passengers will board surface transportation for the final leg of their trip. The adjacent colossal control tower will be the heart of the operation of the airport. In addition to the control cab, the tower will house the electronic gear to insure the safe landing and dispatch of all planes using the airways in the metropolitan area.

In addition to such mundane things as ticketing counters and waiting rooms, the terminal building will also contain such necessities as restaurants, snack bars, banks, newsstands, limousine dispatching offices and the plethora of consumer services which are essential not only for the convenience of the traveling public but also to help defray the cost of maintaining this tremendous air terminal development.

Because the central terminal area is so gigantic, 655 acres, it has been necessary to divide it into a series of mutually compatible landscaped areas. The intricate road system bisecting these areas will be relieved by interesting planting and huge reflecting pools. Wallace Harrison, with his wealth of experience on such outstanding structures as Radio City and the United Nations, has laid out a series of interrelated parking lots, roads and pools which make this development not only functionally adequate but architecturally pleasing. Architects for the various domestic airlines working closely with the Port Authority and its consultants are evolving a series of individual terminals estimated to cost 30 million dollars. These terminals, in conjunction with the Port Authority development outlined above, will occupy an area three quarters the size of Central Park.

In the development of our International Arrival Building and the adjacent Airline Wing Buildings, provision has been made for about 50 percent expansion as air commerce at this airport reaches its ultimate potential.

We in the Port Authority who have lived so closely with this infant industry for the past decade are acutely aware of the tremendous strides it has taken in that time. We believe that today's infant prodigy will become the giant of the transportation industry.

(This article was abstracted from the paper presented by Mr. Kyle at the ASCE Annual Convention, before an Air Transport Division session presided over by Terry J. Owens, a member of the Division's Executive Committee.)

THE READERS WRITE

More ways to use fractions of inches

TO THE EDITOR: The method described by Willis G. Pratt in his article, "Fractions of Inches Simplified" in the July issue, is simple, convenient, easily adaptable, and as such should find wide use.

In addition to the example indicated, it is possible to use this method for the division of fractions. To divide 167 ft $8^{59}/_{64}$ in. by 17 it is merely necessary to follow a systematic arrangement—divide, subtract, convert the difference into smaller units, add the converted units, and repeat, as shown in Example 1:

	9′	10″	6^{16}	2^{64}
17 |	167′	8″	14^{16}	3^{64}
	−153′			
	14′ =	168″		
		176″		
		−170″		
		6″ =	96^{16}	
			110^{16}	
			-102^{16}	
			8^{16} =	32^{64}
				35^{64}
				-34^{64}
				1^{64}

Example 1

To reduce a product to its lowest form, the following system may be used. Starting with the smallest unit, subtract the next lower number from it, which is exactly divisible by the ratio of the two adjacent units. Then convert the same next lower number to its adjacent units, add and repeat. The result is the dividend of Example 1 except for the remainder. See Example 2:

9′	10″	6^{16}	2^{64}
			×17
153′	170″	102^{16}	34^{64}
		8^{16} =	-32^{64}
		110^{16}	2^{64}
	6″ =	-96^{16}	
	176″	14^{16}	
14′ =	−168″		
167′	8″		

Example 2

A convenient method of reducing a number to its lowest fractional form is indicated by Example 3:

Example 3

$14^{16} = 56^{64}$

2^{64}

8″

167′

167′	8″	58^{64}
167′	$8^{29}/_{32}$″	

A series of numbers can be conveniently subtracted from one number and the entire process can be combined into one operation as shown in Example 4:

167′	2″	3^{16}	1^{64}
166′	13″	18^{16}	5^{64}
−9′	10″	6^{16}	2^{64}
−21′	5″	2^{16}	0^{64}
−100′	11″	11^{16}	3^{64}
−30′	0″	0^{16}	1^{64}
−160′	26″	19^{16}	6^{64}
		1^{16} =	-4^{64}
		20^{16}	2^{64}
	1″ =	-16^{16}	
	27″	4^{16}	
2′ =	−24″		
−162	3″		
			3^{64}
		14^{16} =	56^{64}
	10″		
4′			
4′	10″		59^{64}
4′	$10^{59}/_{64}$″		

Example 4

The line after the positive number is left blank initially. Add all the negative quantities first and reduce the result to the lowest form as in Example 2. From this negative result determine how the positive number should be most conveniently arranged and do this on the blank line.

In Example 4, the reduction to the lowest form can be omitted as shown in Example 5:

167′	2″	3^{16}	1^{64}
164′	36″	33^{16}	9^{64}
−9′	10″	6^{16}	2^{64}
−21′	5″	2^{16}	0^{64}
−100	11″	11^{16}	3^{64}
−30′	0″	0^{16}	1^{64}
−160	26″	19^{16}	6^{64}
			3^{64}
		14^{16} =	56^{64}
	10″		
4′			
4′	10″		59^{64}
4′	$10^{59}/_{64}$″		

Example 5

However, more thought is required in obtaining a convenient arrangement and consequently the risk of error may be somewhat greater than by the method shown in Example 4. The preference of the individual is the deciding factor.

While the above methods are largely mechanical in operation, I believe that the sources of error are reduced and the accuracy and simplicity of the system warrants the few minutes expended in learning to use it. Any non-decimal system of units—such as pounds, shilling, pence; degrees, minutes, seconds; or days, hours, minutes, seconds—can be readily manipulated in the same way.

A. J. GLASER, A.M. ASCE
Pasadena, Calif.

Technician or engineer? Young graduates must choose

TO THE EDITOR: The article by Herman L. Danforth, M. ASCE, on "What's Wrong With Engineering Education" (May 1955) interested me greatly. However, I find myself in disagreement with him. He states that we are doing a notable job of training technicians but not so good a job in educating engineers. I do not believe that we are necessarily doing either.

One main function of an educational system is to awaken the inherent ability of the student to think effectively. In engineering the attempt is to stimulate this thinking along scientific lines. Mr. Danforth lists four criteria to which an engineer should conform. I have no quarrel with these criteria but only with his effort to blame engineering institutions for the failure of the average engineer to live up to these criteria. I would like to repeat particularly the second and third of his criteria:

"2. He has the ability to think broadly—to relate problems to human values, to ultimate human wants and needs.

"3. He has a basic understanding of the behavior of both materials and people under varying situations. He is not content to accept and use standard formulas, loadings or allowable unit stresses without consideration of unique conditions. He is apt to consider uncoventional solutions for uncoventional problems."

Where in a four- or five-year crowded undergraduate curriculum does Mr. Danforth believe we can introduce subjects which will enable a student to cope with condition No. 2 or No. 3? How does he believe the curriculum should be revised to accomplish these aims? Most engineering institutions are aware of the need of making students more alert to their responsibilities as members of the community, city, state and nation. This need is being met by dropping courses which emphasize skills and introducing the humanities. However, I doubt that by so doing any institution will claim that its students are enabled to satisfy condition No. 2 or No. 3. These conditions can only be satisfied by an engineer who has maturity and judgment, developed through experience. Maturity and judgment are not developed in the classroom, but only by experience on the job.

While most engineering graduates have a good general understanding of the behavior of metal under varying conditions it is too much to expect them to have a basic understanding of what people will do under varying conditions. I doubt that even our prominent engineers would make that claim. Even psychologists are not agreed about human behavior. As for standard formulas, no conscientious teacher will encourage students to become dependent on them, but instead will urge them to be critical of formulas and not to be afraid to deviate from convention when conditions permit.

When an engineering graduate leaves college he is neither an engineer nor a technician. He is merely a person about whom a college signifies, by handing him a diploma, that he has the basic foundation for engineering. With experience in his chosen field, plus additional study, either formal or informal, he will develop into an engineer.

Whether a person is to be a technician or an engineer depends only on that person. If he is content with his little niche and with merely drawing a salary, then he will probably become a technician. If, on the other hand, he is constantly striving to increase his knowledge of engineering and is not afraid to tackle new problems, then he will develop into an engineer. The choice lies with the individual, and is not a function of the educational institution.

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Professional status is earned by altruistic service

TO THE EDITOR: With much interest and some concern I have read several articles on the professional status of engineers that have appeared in recent issues.

The word "profession" is derived from the Latin *professus*, past participle of *profiteri* (*pro* + *fateri*), meaning to confess or profess. The word has a religious connotation in that it was most often used to denote a public avowal or an open declaration, as in the case of a profession of faith. Even in the occupational sense, the word had a religious connotation, for the dictionary gives "calling" as a synonym. This is not strange since men entering a profession took oaths or vows of service.

In the dictionary, the "three professions" or the "learned professions" are listed as theology, law, and medicine. Looking backward on these professions, we find a rich history of service. The reputation, or the status, of the medical profession was not built on the fees, high or low, that were charged, but on the services that were rendered—on the labors of the selfless country doctors who braved blizzards in the North Woods to minister to the sick, of the research men who went into the swamps to seek the cause of Yellow Fever, of the men who used themselves as guinea pigs in order to conquer diseases, and of the many, many others who put monetary returns second to healing, whether in active practice or in the laboratory.

Similarly the reputation or the status of the legal profession was not built on the practice of corporation lawyers earning high fees, but on the efforts of those who stood for justice even when it meant the unpopular side, who in the great American tradition went to bat for the under dog, and as judges on the bench handed down decisions in the cause of equity which today are widely quoted in the courts of this country and of the world.

As for the ministry, which represents the learned profession of theology, there is no need to detail its efforts to serve mankind without thought of personal advantage or pecuniary gain.

It seems clear that though today in these three professions many have strayed from the noble principles that earned for them professional status, it is still selfless service to one's neighbor and willingness to go the second mile that place them high in the estimation of the people of the community.

In the engineering profession likewise there are many who give of themselves selflessly in serving others, often forgetting monetary returns or at least placing service far above remuneration. However, in comparison with the three "learned professions," engineering does not have as rich a background of service nor as wide a reputation for altruistic effort in this age of materialism.

If engineers are to enjoy professional

Prestressed, precast units for shell roof in England

TO THE EDITOR: The News Brief story, "First Precast Circular Shells Erected in United States," by George J. Hartman, in the July issue, p. 86, shows an interesting use of precast roof units. It may be of interest to describe a heavier unit, of precast, prestressed concrete being used for a structure in England. A new Technical College has been designed for the Education Department of the Corporation of Kingston-upon-Hull, and the workshop block, which is the first stage, has been recently completed.

This single-story building is 312 ft long by 192 ft wide, and is planned on a 24 × 24-ft grid. It is divided into four blocks by 12-ft corridors running the width of the building. The frame consists of a series of north-light bays of reinforced precast concrete members, post-tensioned after erection by the Lee-McCall system. The shell roof is also made up of precast units, and each north-light and roof unit together span the 24 ft of the grid. The corridors have flat roofs, consisting of reinforced precast concrete slabs, which rest on tubular rollers to allow for expansion and contraction of the building.

Each unit of the shell roof is $2^1/_2$ in. thick, measures some 16 ft × 24 ft, spanning in the 24-ft direction, and weighs about 7 tons. These units are all precast and pretensioned. In view of their size they are being cast on the site, in batches of eight, on a prestressing bed which has been set up in a bay of the previously constructed ground floor. Eight gutter units are cast simultaneously with eight roof units

The roof units are fixed by laying them on the frames in final position, clamping them down, and placing a filling of concrete between adjacent units over the frame ribs.

A high quality of concrete is required. The mix is 1:1: 2, with a water-cement ratio of 0.34. Washed Trent River sand and gravel are used. With rapid-hardening cement, 5,000-psi concrete is obtained in two days, enabling detensioning to take place. Concrete is placed by derrick from bottom-dumping skips, and compacted with the aid of a pneumatically-vibrated, traveling tamper, shaped to the contour of the roof unit.

One of the two cranes is used to remove the units from the casting bed and to serve the second crane at work on the superstructure.

Architect for the structure is F. Gibberd; consulting engineers, Scott & Wilson, Kirkpatrick & Partners; and general contractor, William Moss & Sons, Ltd.

G.M.J. WILLIAMS, A.M. ASCE
Scott & Wilson, Kirkpatrick & Partners
London, England

Units are lifted in a frame consisting of two shaped channels, one at each end, with welded tubes connecting channels to pyramid sling. Frame is fixed to shell roof unit by bolts cast in concrete and later burned off. Aerial view shows building during construction. At left, note prestressing bed for shell roof units and that for corresponding gutter units immediately adjoining it to the left.

status they must earn it through service. In a democratic society we do not build a status for ourselves; it is conferred upon us by those who observe the fruits of our labors. Historically this is true, and actually it is the only path to the desired goal.

KAZ KAWATA, J. M. ASCE
Div. of World Missions, Board of Missions, Methodist Church
Station: Jullundur City,
Punjab, India

Pitfalls in store for builders of large tanks

TO THE EDITOR: In his article in the September issue, "Big Prestressed Concrete Tanks Built with Precast Panels," Mr. Doanides gives a brief description of the construction of two tanks in the far distant Orange Free State of South Africa, which may induce some lovers of this new art to advocate the building of similar tanks nearer home. Engineers should be warned that there are many pitfalls in store for them when they undertake to build such large tanks. Mr. Doanides does not mention any difficulties encountered but from the statement that the construction took eight months, the writer believes there were plenty of them.

Many accidents have occurred in the past in the construction of large tanks whether of concrete, wood, or even steel. Around 1910 a concrete tank built in Southern California, about 600 ft in diameter and about 25 ft high, failed not by ring stresses but by cantilever action as a retaining wall would fail. Smaller tanks than that have failed by shear action. Secondary stresses such as are likely to occur in large tanks were analyzed by Bresse in 1867, by Grashof in 1878, by Mueller-Breslau in 1896, and by many others since then.

Some of the pitfalls which an amateur will encounter in the construction of large tanks are briefly as follows:

1. It is difficult to build the top surface of the ring girder at the base of the wall perfectly straight and level so that the concrete staves have an even bearing. The illustration on page 45 of the September issue does not show what contrivances were used to hold the staves vertical and in proper position.
2. The prestressing causes a movement of the staves at the base in an inward direction of about $^3/_4$ in., and the water pressure causes an outward movement of about $^1/_2$ in. These movements cause a grinding action, making the base a very vulnerable part of the structure.
3. The prestressing, furthermore, causes bending of the staves about a horizontal axis, and the resulting moments have to be carefully analyzed to prevent cracks in the walls.

L. J. MENSCH, M. ASCE
General Contractor
Evanston, Ill.

Another equation helpful in computing prestress losses

TO THE EDITOR: The article, "Method Presented for Computing Steel Prestress Losses," by Messrs. Stephenson and Jones, in the August issue, clearly points the way toward a more rational basis for computing stress losses in prestressed concrete. It is encouraging that the old idea of choosing an arbitrary stress loss of 15 or 20 percent is being discarded. The formula proposed by this article is similar to the one recommended in the "Criteria for Prestressed Concrete Bridges," published by the Bureau of Public Roads. Both take into account all the factors known to contribute to stress loss.

In the application of either formula, it is necessary to compute the average stress or the average strain in the concrete from end to end of the beam at the level of the centroid of the steel (Fig. 1). Some offices do this by averaging the stress at the ends, the quarter points, and the center. The process gets more time consuming as the number of cables increases, and when the cables follow several different profiles. This writer has derived an equation for finding the average strain which may be applied to any beam of constant (or nearly constant) movement of inertia and containing any number of parabolically curved cables. Though it may appear too complicated for practical use at first glance, the time required for its application should be no longer than that required to find and average the strains at several points. Furthermore, the results obtained are more "exact" than the averaging method.

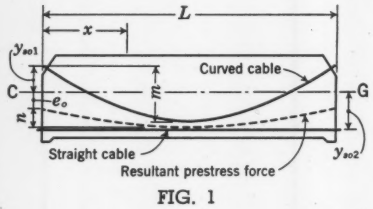


FIG. 1

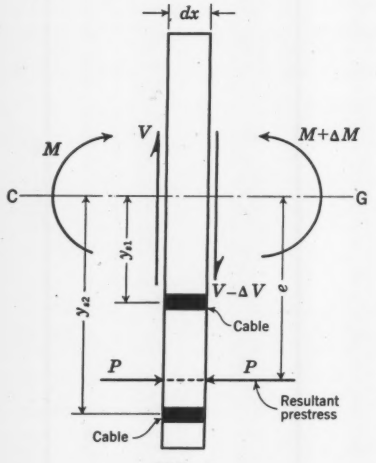


FIG. 2

The derivation is developed from considering a differential length of the beam subjected to the forces of prestress and external load (Fig. 2). An expression for the unit shortening of the differential length is written and the total shortening of the entire beam is found by integration after expressing all factors as suitable functions of X. The step-by-step mathematical procedure is unimportant in this letter, but the final result can be expressed by the following formula:

$$U_e = \frac{P_i}{A_c E_c} + \frac{P_i}{E_c I_c}\left[e_o\left(Y_{so} + \frac{2}{3}m\right) + n\left(\frac{2}{3}Y_{so} + \frac{8}{15}m\right)\right] - \frac{wL^2}{E_c I_c}\left[\frac{Y_{so}}{12} + \frac{m}{15}\right] \quad (1)$$

where (See Fig. 1),

U_e = average unit strain in concrete at level of steel
Y_{so} = distance at end of beam from centroidal axis of concrete to center of cable under consideration. (In Fig. 1, subscripts are used to differentiate between cables.) This value (in inches) is positive if the cable is below the centroidal axis, negative if above.
m = deviation at center of beam of parabola which cable follows, in.
e_o = eccentricity at end of beam of resultant prestress force, P_i, in.
n = deviation at center of beam of parabola which resultant prestress force follows, in.
w = uniform dead load which is acting at the time prestress is established, lb per lin. in.
P_i = initial resultant prestress force, lb
L = length of beam, in.
A_c = area of concrete, sq in.
I_c = moment of inertia of concrete, in.^{4}
E_c = modulus of elasticity of concrete, lb per sq in.

For the special case in which all the cables are at the same eccentricity,

$e_o = Y_{so}$, and $m = n$. Therefore

$$U_e = \frac{P_i}{A_c E_c} + \frac{P_i}{E_c I_c}\left(e_o^2 + \frac{4}{3}me_o + \frac{8}{15}m^2\right) - \frac{WL^2}{E_c I_c}\left(\frac{e_o}{12} + \frac{m}{15}\right) \quad (2)$$

If all cables are at the same eccentricity and all are straight,

$$U_e = \frac{P_i}{A_c E_c} + \frac{P_i e_o^2}{E_c I_c} - \frac{wL^2 e_o}{12 E_c I_c} \quad (3)$$

Finally, if all cables are straight and follow the centroidal axis,

$$U_e = \frac{P_i}{A_c E_c} \quad (4)$$

From Eq. 1 it is apparent that each cable is accompanied by a particular average unit strain depending on its profile. Each separate cable in a prestressed beam may have a different stress loss depending on its location and profile. The last term in Eq. 1 can be used to compute the average unit strain in the steel due to an applied uniform load. This may be useful in computing secondary stresses or in esti-

(*Continued on page 92*)

SOCIETY NEWS

Notable Technical Program, Induction of Officers, and Award of Honors Feature Successful Annual Convention

Another highly satisfactory Annual Convention has passed into ASCE meeting history. Each year the Annual Convention committees of the Metropolitan Section in charge of arrangements seem to outdo themselves at the difficult task of providing perennially fresh and interesting Convention programs.

This year's Convention—held at the Statler Hotel in New York, October 24-28—offered unusual technical and social programs; a battery of famous speakers, including New York's mayor, the Hon. Robert F. Wagner; the traditional induction of new officers and presentation of honors and awards; 52 committee meetings; and tours of a number of metropolitan projects. On hand for these events were over 2,000 engineers, representing Europe, Asia, Africa, and North and South America. John R. Zehner was Convention chairman and Barclay G. Johnson, vice-chairman.

Professional Cooperation Luncheon

In the first appearance of a New York mayor at a Society Convention, Mayor Wagner took time from a busy schedule to attend the Professional Cooperation Luncheon Monday noon, which was sponsored by the Committee on Conditions of Practice. Expressing his appreciation of the "integrity and ability" of engineers, with whom he works closely, the mayor said he has a strong feeling of kinship with the profession. He noted that "for 103 years the American Society of Civil Engineers has been concerned with the traffic problem of this city," and that "when the eventual solution of the traffic problem is reached, civil engineers will have had a major role in that solution, just as, for many generations, they have been in the forefront of the city's development." He called the great Metropolitan area of New York "the triumph of the engineer," and said that the people of the City of New York accept engineers' "good works as assured benefits of everyday life."

In the featured address at the Professional Cooperation Luncheon, Carlton S. Proctor, Past-President of ASCE and a leading figure in the development of Engineers Joint Council, gave a searching analysis of the professional unity situation. His talk, which was entitled "EJC—National and Regional Unity in the Engineering Profession," emphasized that engineers must unite with other members of the profession if they are to "achieve the status they have long sought." Mr. Proctor's address appears in its entirety in this issue (page 46). Mason Lockwood, Vice-President of the Society and chairman of the Committee on Conditions of Practice, was toastmaster.

Conditions of Practice Session

Hundreds of engineers interested in engineering registration and engineering education gathered in the Statler Skytop Monday afternoon for a Conditions of Practice session. The first half of the afternoon was devoted to answering the question, "Is Engineering Registration a Professional Asset?" Both principal speakers—Newell L. Nussbaumer, A.M. ASCE, of Buffalo, N.Y., who discussed Eastern experience with registration, and William A. White, A.M. ASCE, of Sac-

The Hon. Robert F. Wagner, mayor of New York (top view) greets Convention visitors and ASCE Past-President Carlton S. Proctor (immediately above) delivers main address at Professional Cooperation Luncheon. In lower left photo, Past-President D. V. Terrell (center) presents Enoch R. Needles to President Glidden for induction into office as 87th President during annual business meeting. At Sanitary Engineering Luncheon (right-hand photo) are Ralph Fuhrman, chairman, Sanitary Engineering Division; Speaker Neil MacNeil; Francis Elder, president U.S.A. section, I.A.S.E.; and Executive Secretary William H. Wisely.

ramento, Calif., who summed up Western experience—agreed that licensure is a protection to the public and that it has upgraded the status of the profession. Mr. Nussbaumer, a consulting engineer, is a former member of the New York State Board of Engineering Registration, and Mr. White is executive secretary of the California Board of Registration for Civil and Professional Engineers.

Distinguished engineering educators headed up the symposium on "Engineering Education—How Much Science and How Much Technology." L. E. Grinter, M. ASCE, dean of the Graduate School at the University of Florida and chairman of ASEE's Committee on Evaluation of Engineering Education, said that, as a result of its recent survey of engineering curricula, the Committee on Evaluation is recommending less specialization and more attention to the basic sciences, the engineering sciences, and the liberal arts. There is wide agreement that technical competence is not enough, he reported, and that there is need for better scientific grounding. The Committee on Evaluation sought in its survey to determine what curricula changes are necessary to keep pace with today's rapidly advancing technology.

The other major speaker, Benjamin A. Whisler, M.ASCE, head of the civil engineering department at Pennsylvania State University, demanded engineering curricula emphasizing "truly engineering" subjects. Said Professor Whisler, "Present trends in engineering education are toward the inclusion of much more mathematics, physics (including atomic physics), theoretical mechanics and similar courses. These courses are being expanded in order to prepare the graduate engineer for entry into development and research activities and are at the expense of those courses which emphasize the truly engineering aspects of the curricula." He went on to say that the engineer "is continually required to make decisions which represent compromises with the theoretically best solution to a problem. The educational institution can do little to provide the experience needed to make such decisions, but it should do everything it can to provide a basis for making such judgments by indicating to the student the part such judgment plays in the work of the engineer and by providing in his education the opportunity for exercising judgment . . . Such training cannot be part of basic courses in mathematics and physics, but must be part of the advanced courses. . . in which the principles of science are applied to specific, practical engineering problems."

Sanitary Engineering Luncheon

The Sanitary Engineering Division, the Metropolitan Section's Sanitary Group, and the Inter-American Association of Sanitary Engineers cooperated in sponsoring a Sanitary Engineering Luncheon on Tuesday. In a talk entitled, "Public Planning from the Businessman's Point of View," Neil MacNeil, former editorial director of the Hoover Commission, spoke on the Commission's water resources report which was released last June. Saying that a powerful public power lobby has been organized to fight the report, Mr. MacNeil urged engineers to back fully the work of their colleagues on the Commission. It is absurd, he declared, to say that the Commission is opposed to public power, when Hoover Dam itself—named for the man who headed it—set a pattern for multi-purpose public power projects.

Mr. MacNeil emphasized the need for coordination of government agencies and activities in the interest of economy and efficiency, by pointing out that today there are 74 agencies reporting directly to the President, that the government is operating over 3,000 businesses, and that there are 34 agencies for foreign aid. These are a few of the revelations of the Hoover Report.

Annual Business Meeting

In keeping with the importance of high

ways in the national picture, they were stressed in the Wednesday morning ceremonies by both retiring President William R. Glidden and his successor, Enoch R. Needles, who took office at the end of the session. Mr. Glidden, in summing up important ASCE activities during his year in office, spoke of the new task committee that has been formed to explore the highway manpower situation and commented on the conspicuous part highways (with five technical sessions) were playing in the Convention program. He termed the failure of Congress to act on the President's Highway Program a "shock and disappointment to the nation," and ventured the opinion that such interest has been aroused in the issue, it is almost certain it will carry into the new congress.

In his inaugural address, which will be published in the December issue, Mr. Needles touched on the many satisfactions inherent in a civil engineering career by reference to the tremendous metropolitan developments that have come within the range of his observation and experience. He brought out the fact that in the decade since the close of the war the number of registered motor vehicles in the country has more than doubled. However, "because of high costs and greatly limited funds the highways in general have remained of 1942 vintage." Mr. Needles sees the modern toll expressway, built through the sale of revenue bonds and paid for by the user, as a partial answer to the problem.

Though civil engineering has solved many of our problems, problems demanding a civil engineering solution still remain in almost every field. Some of these problems Mr. Needles posed to his audience of engineers. "I ask these questions," he said, "not to baffle, but to picture in part how brilliant the future may be, and what a great and vital part in that future the civil engineer will occupy, as he helps to answer the questions we may propound."

ASCE Prizes Presented and New Officers Inducted

As usual an important feature of the Wednesday morning business session was the presentation of Society prizes for papers in TRANSACTIONS and CIVIL ENGINEERING. This year fifteen engineers were present to receive their prizes in person. They were headed by that dean of prize winners—Karl Terzaghi, Hon. M. ASCE, who received the Norman Medal for the fourth time for a paper describing important new findings in the field of anchored bulkheads.

At the close of the meeting Mr. Needles took office as 87th President of the Society. Also installed were two Vice-Presidents—Frank A. Marston, of Boston, Mass., for Zone 1, and Glenn W. Holcomb, of Corvallis, Ore., for Zone IV. The new Directors inducted are John P. Riley, District 1; Carey H. Brown, District 3; Mason C. Prichard, District 5; Robert H. Sherlock, District 7; R. Robinson Rowe, District 11; Louis E. Rydell, District 12; and Clarence L. Eckel, District 16.

Wednesday Membership Luncheon

An important feature of the annual Membership Luncheon, held Wednesday noon, was the presentation of certificates of Honorary Membership in the Society to four outstanding engineers. In the Society's entire 103 years of existence only 168 persons have held Honorary Membership, which retiring President Glidden termed "the highest recognition of acknowledged eminence in the profession."

Honored at the Membership Luncheon were Frank A. Banks, of Coulee Dam, Wash.; Rear Admiral Leo O. Colbert, of Washington, D.C.; Park H. Martin, of Pittsburgh, Pa.; and John I. Parcel, of St. Louis, Mo. In the citations accompanying the awards, Mr. Banks was honored as "world-renowned engineer and pioneer staff member of the Bureau of Reclamation, in recognition of his service

Lower left view shows William Zeckendorf addressing Wednesday Membership Luncheon. To his right are Mr. and Mrs. John R. Zehner, and to his left President and Mrs. Needles. On platform during induction ceremonies (lower right) are ASCE Vice-Presidents Enoch R. Needles (now President), Louis R. Howson, Mason Lockwood (retiring), and Frank L. Weaver. In scene above President Needles hands gavel, symbol of the office to retiring President Glidden. President Glidden is seen at the rostrum in the top photograph presenting his farewell address.

to mankind in the building of great dams and the development of the water resources of the earth." The honor was conferred on Admiral Colbert "in recognition of his contribution to the advancement of the profession through the surveying and recording of the uncharted contours of the earth during a long and distinguished career in the United States Coast and Geodetic Survey." Mr. Martin was hailed as "planning and executive genius, famous Pittsburgh engineer, leader in a major improvement program that exemplifies community planning at its best." Mr. Parcel was cited as "eminent engineering teacher and consultant, and tireless worker on the committees of the Structural Division, whose writings have extended the frontiers of engineering science."

William Zeckendorf Speaks

The Wednesday luncheon was also distinguished by an address made by William Zeckendorf, president of Webb & Knapp, Inc., New York, dynamic realty developer and a gifted speaker. In a broad sense Mr. Zeckendorf's talk dealt with the "Future of the Central City" with particular reference to New York City. The planning and development problems that confound us today, he called "a continuance of what has happened before—mechanized, thanks to the genius of engineers." Cities must be able to analyze their needs and go about solving them he emphasized.

New York is no longer an important industrial city, Mr. Zeckendorf said. Its industries have decentralized and recentralized all over the United States. With its horizontal expansion curtailed by geographical limitations, the city began to lose its factories, one by one. Yet today New York is at the very pinnacle of its development. Never has metropolitan construction been so high. Since 1947 more office building space has been completed in New York than exists in the whole of Chicago, Mr. Zeckendorf reported. This brilliant recovery after the death blow of losing its industry, he said, is directly attributable to the fact that "New York realized in time it had another purpose in the national orbit—it creates the dream."

The tendency to get away from the problems and tensions of the city by moving to the suburbs, Mr. Zeckendorf sees as a real danger that we may become a nation of suburbia—"where there is no place to go to get away from the city." To avoid such a situation, he suggests the need for greater verticalization in building. He further suggested a green belt around urban areas where there would be no building at all. Perhaps, he concluded, the surge to suburbia poses a new concept of city life, in which regulations will say "not, you can't build higher, but you mustn't build lower."

Rich Technical Program

It would be almost impossible to find a civil engineering interest overlooked in the technical program that was of course the heart of the Convention. The thirty-four sessions—arranged by twelve of the Society's thirteen Technical Divisions and including an all-day meeting of the City Planning Division at Princeton University—make it almost equally impossible to single out papers for special mention. Three of the Convention papers are printed elsewhere in the issue, and others are scheduled for later issues and for publication as Proceedings Papers.

From Seoul, Korea, comes Prof. Tae-Sang Won, dean of Seoul National University, to bring greetings to President Needles from the Korean Society of Engineers, of which he is a director and former vice-president.

The five Highway Division sessions—covering many aspects of the nation's prime problem of building good roads and finding highway engineering manpower to sustain an adequate program—have been mentioned. There were also five sessions of the Society's most recently established technical group, the Engineering Mechanics Division. Engineers attending the latter sessions reported that the papers, ranging from a study of "Boundary Layer Development at an Open Channel Inlet," to "Lateral Buckling of Eccentrically Loaded I-Columns," were "in unusual degree factual and down to earth."

With the August and October floods uppermost in the minds of many, there was much interest in a Hydraulic Division session dealing with flood plain zoning. Out of a number of thoughtful papers and talks, devoted broadly speaking to the thesis that flood plain zoning does not have the drawbacks of restrictive structures which often cause worse floods, came the general recommendation that protection against maximum flood is not always possible or even desirable. Usually protection can be only partial, depending upon flood frequency. Before the motor age, as one of the papers noted, it was almost necessary for industry to locate along waterways. Today there is no such necessity, and all the speakers stressed "the need for educating John Q. Public on the risk of selecting a dangerous site." It was also suggested that industries benefiting from protective structures might properly be assessed for some of their cost.

Applications of automation in the building industry, discussed by Roger Corbetta, president of the Corbetta Construction Co., proved a popular Construction Division topic. Other Construction Division papers dealt with the "Texas Towers," the foundations for Barnhart Island Bridge (called a contractor's nightmare), banking as related to construction, and modernizing and improving New York's Transit System (it can and will be done, the Transit Authority says).

Inspection Trips

The Construction Division sponsored a field trip to the $35,000,000 New York Coliseum, which is nearing completion in Columbus Circle, a major urban redevelopment area. A Power Division field trip took engineers, including a bus load of enthusiastic Lehigh University students, to the Edward F. Barrett Power Plant of the Long Island Lighting Co., near Idlewild Airport. Initial capacity of the plant, which is now in an advanced stage of construction, will be 156,000 kw. The big Convention trip this year was an all-day conducted tour of the New York Navy Yard in Brooklyn on Friday. The many interesting installations and operating features of this great yard included a reconstructed drydock of latest design and a new-type supercarrier which is under construction.

Ambitious Ladies' Program

The Ladies Convention program this year was said by many to be one of the best ever arranged for distaff visitors. It included a visit to the new luxury liner, the *U.S.S. United States*; an all-day trip to Philipse Manor in the heart of the Washington Irving country; a luncheon and fashion show at the Waldorf-Astoria; and breakfast at the Charleston Gardens, followed by hints on interior decoration given by Charles Haight, one of the decorators on the White House reconstruction project. Credit for this unusually fine program goes to Mrs. John R. Zehner, chairman of the ladies' program, and Mrs. Barclay G. Johnson, vice-chairman, and their hard-working committee.

Actions of ASCE Board of Direction Briefed

Principal actions of the ASCE Board of Direction, taken at its meetings during the Annual Convention in New York, October 24–28, are summarized here.

Task Committee on Convention Procedures

A special task committee has been approved to review all Convention policies and practices and to develop a handbook of Convention Procedures for the guidance of those responsible for the planning and conduct of future Conventions.

Public Works Congress

Authorization was given to holding a Public Works Conference jointly with the American Institute of Architects in Washington this coming January (page 78).

Washington Office to Be Closed

In the interest of more efficient operation, the Washington Office of the Society is to be closed around the end of January. The functions of this office are to be accomplished by the staff at Society Headquarters and by the officers of the Society.

Technical Division Enrollment

Members of the Society are now privileged to enroll in two Technical Divisions and to receive the Proceedings Journal of each as of January 1.

February 1957 Convention

Approval was given to holding the February 1957 Convention at Jackson, Miss.

Task Committee to Study Society Functions

The Board authorized formation of a special task committee for the purpose of making "a complete new study and investigation as to what the Society can do to improve the economic status of its members, such study and investigation to be a positive approach to the problem with the object of determining what the Society might be able to do rather than what it cannot do, such study to determine the effect of any proposed recommendations on the tax status of the Society and on its relations with EJC and UET, and that the headquarters staff and Society's legal counsel be instructed to assist the committee."

Amendment of Code of Ethics

Amendment of Article 4 of the Code of Ethics has been approved by the Board of Direction and will go to the membership for ratification. The purpose of the amendment is to define more specifically the prohibition in the Code against "participation in competitive bidding on a price basis to secure a professional engagement." The proposed new provision reads, ". . . to invite proposals for the performance of professional engineering services or to state a price for such services in response to any such invitation when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer."

The full report of the Committee on Professional Practice will appear in the December issue of CIVIL ENGINEERING.

Joint Manual on Professional Practice

Authorization was given for the formation of a joint committee with ASME for the preparation and publication of a manual of professional practice for the two societies. The ultimate objective is to expand the scope of the joint committee to include all the branches of the profession.

ASCE Local Section Participation in EJC

Action was taken to encourage the participation of ASCE Local Sections in federations for the purpose of affiliation with EJC.

Group Disability Insurance Plan

The Group Disability Insurance Plan has been reviewed by a special task committee, reporting to the Board. The value of the plan was reaffirmed by the Board as a proper and valuable service to members. Greater participation in the plan was urged.

Mead Prize Winners

Winners of the 1955 Daniel W. Mead Prize Paper Competition were announced. They are Merle H. Banta, J. M. ASCE, Junior Member Award, and J. E. Abbott, Student Award.

Nuclear Engineering and Science Congress Slated for December

The public will have its first chance to get a good look at atomic energy in industry, government, education, medicine, and agriculture at the Nuclear Engineering and Science Congress and the Atomic Exposition to be held in Cleveland, Ohio, December 12 through 16. The exposition, displaying everything from models of the atom to operating nuclear reactors, will be open December 10 and 11.

Coordinated by Engineers Joint Council, the congress will represent a cooperative effort of the engineering and scientific societies of the nation, more than twenty-five of which will take part. The 300 papers describing nuclear developments will be the heart of the program. Running concurrently with the congress and supplementing its discussions of nuclear developments, the Atomic Exposition will display the current actual tools of atomic developments—reactors, components, equipment, materials, and services in the atomic power field. The products of nuclear energy are already in use by over 3,000 industrial firms in the United States. Though impressive, this is but a small part of the potential application.

EJC President Thorndike Saville sums up the primary purpose of the congress in these words: "The horizons for the peaceful application of atomic developments are, as yet, not even imagined. This highly interrelated family of developments is, as yet, very much in the 'idea for application' stage. Therefore, it is of enormous importance to present to those interested a panoramic view with detail as a proper measure of current opportunity and the vastness of the potential." Noting that the congress promises to be the largest gathering of engineers and scientists ever held, Dean Saville says that as such, "it will be a major opportunity for the communication of ideas and developments among the many thousands of persons in industry, business, agriculture, and medicine, for whom the technology of the atom is increasingly important."

According to Dr. John R. Dunning, chairman of EJC's General Committee on Nuclear Engineering and Science, the week of meetings should provide "important guideposts to the nation's peacetime development of nuclear energy." Declassification of restricted information following the Geneva meetings will for the first time make possible open discussion and planning at the Cleveland Congress, Dr. Dunning said.

Information about the congress program is available from Paul Lange, Secretary of EJC, 29 West 39th St., New York 18, N. Y. Information about the atomic exposition may be obtained from Athel Denham or Paul Stewart, 931 Book Building, Detroit 26, Mich.

EUSEC Conference is shown in action, Copenhagen, September 1955. President Glidden and Executive Secretary Wisely of ASCE, and President Morgan and Secretary Davies of ASME are at right and left of far corner of table.

EUSEC Conference Held in Copenhagen

Another conference of representatives from the engineering societies of western Europe and the United States (EUSEC) was held in Copenhagen, Denmark, September 5–9. The Institution of Danish Engineers, of which George Dithmer is president and Ove Guldberg secretary, was the gracious host.

President Wm. Roy Glidden and Executive Secretary W. H. Wisely represented ASCE, and President David Morgan and Secretary Clarence E. Davies represented ASME.

Representatives were present from the Osterreichescher Ingenieur und Architekten Verein (Austria); Société Royale Belge des Ingénieurs et des Industriels; Dansk Ingeniørforening (Denmark); Suomalaisten Teknikkojen Seura and Samarbetsdelegationen i Finland; La Société des Ingenieurs Civils de France; Verein Deutscher Ingenieure (Germany); Koninklijk Instituut van Ingenieurs (Holland); Den norske Ingeniørforening (Norway); Schweizerischer Ingenieur und Architekten Verein (Switzerland); Svenska Teknologföreningen (Sweden); and the Institution of Civil Engineers, the Institution of Electrical Engineers, and the Institution of Mechanical Engineers (Great Britain).

The primary purpose of EUSEC conferences has been to explore experiences and exchange information about the procedures of the societies represented and of the engineering profession in the several countries. The conferences have provided opportunity for the executives of the EUSEC societies to meet, and to become acquainted in order to facilitate the constructive work of the conference between its meetings.

Among the matters brought to the attention of the representatives at Copenhagen was the future supply and demand for professional engineers in each country. Consideration was given to the extent to which advertising and the solicitation of work by consulting engineers is permitted by each country's code of ethics. Information was exchanged concerning the extent to which offers from an engineering firm for package deals are permitted and practiced—that is, carrying out preliminary investigations, giving advice, designing and constructing a project, and sometimes administering and operating it. Should the participating societies give consideration, in the interests of world economy, to the professional engineers' responsibility to conserve the natural resources of the world? What steps are being taken to collect and disseminate information on the technology of nuclear energy and its applications? What steps have been and are being taken to acquaint members with the benefits that the regular use of abstracts of engineering papers and articles can bring to them?

Without naming the city or the exact date, the representatives decided to hold the next EUSEC conference in the United States in April 1958.

1954 J. Waldo Smith Fellow Reports

Gunnar Sigurdsson, J.M. ASCE, the 1954 J. Waldo Smith Fellow, has reported on an intensive year of study at Georgia Institute of Technology, on the subject of "Discharge Characteristics of an Embankment-shaped Weir." Among the findings reported are:

1. The velocity distribution in the boundary layer over the roadway can be described by a $^1/_7$ power equation.

2. The influence of submergence is primarily a function of the tailwater-head ratio. Minor influences are related to the embankment-height-head ratio and the relative-roughness ratio. The point of incipient submergence occurs, in general, when the tailwater head is about 0.85 times the upstream piezometric head.

3. The upper and lower tailwater limits which define the transition model were studied. The transition range is very sensitive to the small details of form on the downstream shoulder.

While the 1954 Fellow is busy summing up his year of experience under the award, the 1955 Fellow, Peter Monkmeyer (September issue, page 72) is preparing for a full year of research at Cornell University, studying a new and improved design for a flow-metering device.

ASCE Members May Become AAAS Fellows

By a recent action of the Board of Directors of the American Association for the Advancement of Science, ASCE has been added to the list of societies whose members are eligible for automatic elec-

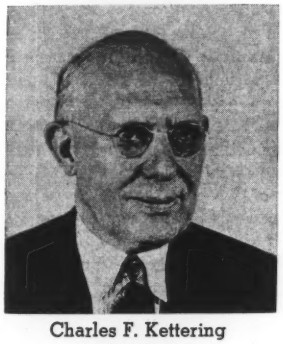
tion as Fellow of AAAS. Both Members and Associate Members are deemed to have met the requirement for Fellow.

AAAS is both a federation of 260 scientific organizations and a scientific society of nearly 50,000 members. Several of its 18 sections are of particular interest to civil engineers: Mathematics, Physics, Chemistry, Astronomy, Geology and Geography, History and Philosophy of Science, Engineering, Industrial Science, and Education.

Fellows are those who have contributed to the advancement of science either by the publication of original research such as for a doctorate, or in some other significant manner, such as advanced teaching, guidance of research, or the accomplishment of work in the fields of applied science not shown by publication, as in engineering. AAAS Fellows are eligible to serve as officers, Board members, on Section committees, and on the council.

A cordial invitation is extended by AAAS to Members and Associate Members of ASCE to join it with immediate fellowship status. Offices are in Washington, D.C. (1025 Connecticut Ave., N.W.) Raymond L. Taylor is associate administrative secretary.

Hoover Medal Goes to Charles F. Kettering



Charles F. Kettering

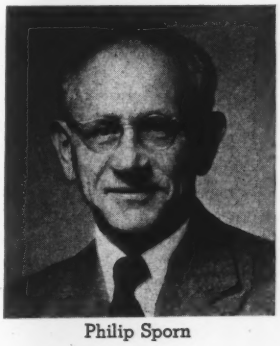
Charles F. Kettering, Hon. M. ASCE, research consultant and director of General Motors Corp., has been named the 1955 recipient of the Hoover Medal "for great, unselfish, non-technical services," according to an announcement from the Hoover Medal Board of Awards. The Board consists of representatives of the four Founder Societies. The eminent scientist-engineer will receive his medal at ASME's Honors Luncheon in Chicago on November 17 during that organization's Diamond Jubilee Annual Meeting celebration.

Dr. Kettering, who is now retired, was a vice-president of General Motors Corp. and general manager of their research laboratories division. In 1927 he founded the Charles F. Kettering Foundation, which he now serves as chairman of the Board, directing researches in the natural sciences. He is also a director of the world-famous Sloan-Kettering Institute for Cancer Research.

Philip Sporn Wins John Fritz Medal

Philip Sporn, M. ASCE, president of the American Gas and Electric Co., New York, has been awarded the John Fritz Medal for 1956. He is cited as "distinguished engineer, pioneer in utility engineering practice, eminent executive, human administrator." He will receive his award at ASME's Honors Luncheon in Chicago on November 17 during the society's Diamond Jubilee Annual Meeting celebration. Mr. Sporn's career with the American Gas and Electric Co. began in 1920. He became chief engineer of the company and its subsidiaries in 1933, and president in 1947. Much of his work has been devoted to the study of nuclear energy, with particular attention to the possibilities of application in the field of power generation for peaceful purposes.

The John Fritz Medal, which was established in 1902 by friends and associates of the late John Fritz, Hon. M. ASCE, is given "for notable scientific or industrial achievement." It is administered by a board of representatives of the four Founder Societies.



Philip Sporn

ASCE Member Wins Freeman Fellowship

Walter J. Tudor, J.M. ASCE, will enter the Massachusetts Institute of Technology this fall as the John R. Freeman Fellow for the 1955–1956 school year. He will study the phenomenon of the standing wave aft of moving ships.

After receiving a B.S. in C.E. from the University of Illinois in 1951, Mr. Tudor worked as a hydraulic engineer with the Army Corps of Engineers and as a structural engineer with Douglas Aircraft. He then studied at the University of Wisconsin for a master's degree and, upon graduation, accepted his present position as naval architect with the Bureau of Ships in Washington, D.C. He plans to study for a doctor's degree in civil engineering while at M.I.T.

Walter J. Tudor

The Freeman Award was established in 1924 by the late John R. Freeman, Past-President and Honorary Member of ASCE.

Defense Secretary Wilson Wins Washington Award

Charles E. Wilson, Secretary of Defense, has been selected to receive the Washington Award for his "significant leadership in engineering and management and for his altruistic devotion to national defense." The award, which is sponsored by the Founder Societies and administered by the Western Society of Engineers, is given to a person "whose contributions to society have gone far beyond the fields of engineering and science."

Secretary Wilson has made many contributions to the development and production of automotive electrical and ignition systems. His outstanding work as an engineer and administrator ultimately landed him in the top executive post of General Motors.

Rocky Mountain Diversion Inspected During Irrigation Conference

Richard Y. Batterton (center), deputy mayor of Denver, welcomes opening session of Irrigation and Drainage Conference. With him are Herbert E. Prater (left), president of Colorado Section, and Andrew P. Rollins, chairman, Executive Committee, Irrigation and Drainage Division.

Denver hosts for the Irrigation and Drainage Conference offered the spectacular front range of the Rocky Mountains as both scenery and a field laboratory for the engineers attending. These attractions and a strong program drew engineers from many of the states and from points as remote as Haiti, Alberta, and India. The three-day program covered every aspect of the field, from measuring devices for farm laterals to cost-allocation theories for multi-purpose water projects. September 8–10 were the dates for the meeting, for which the Colorado Section and the U.S. Bureau of Reclamation cooperated with the Society's Irrigation and Drainage Division in making arrangements.

During the conference, the Division's executive committee made plans for a variety of new activities during the months to come, and heard progress reports of four technical committees engaged in the preparation of new manuals of practice for engineers in the field. Three new committees were authorized: a Water Rights Task Force; a Committee on Research; and a committee to cooperate with Local Section irrigation and drainage groups. Division officers selected are: George N. Carter, chairman; Harry F. Blaney, vice-chairman; John H. Bliss, new member of the committee; and Herbert E. Prater reelected secretary. Other committees meeting at the time of the conference were the U.S. National Committee of the International Commission on Irrigation and Drainage (which worked on plans for an international congress to be held in the United States in 1957); and the Committee on Utilization of Ground Water Storage for Irrigation (which charted progress on its new manual.)

Tours Featured

One full day was devoted to inspection of the spectacular Colarado-Big Thompson Project, and one full day was needed because of the terrain covered, horizontal and vertical, by this vast undertaking. A caravan of cars negotiated mountain roads to view Lake-Granby (a west-slope storage reservoir), pumping plants, dams, the Adams Tunnel to divert the Colorado River water through the Continental Divide to the east slope, power-generating equipment, diversion structures, and distribution works.

A second team visited the laboratories of the U.S. Bureau of Reclamation during its twenty-fifth anniversary celebration, as guests of Leslie N. McClellan, assistant commissioner and chief engineer, Walter H. Price, director of the laboratories, and many other members of ASCE at the Bureau headquarters in the vast Federal Center west of Denver. During this visit, a session was held to discuss the significance of the development and use of new measuring devices, with papers by Ralph L. Parshall, Frank Murphy and Charles W. Thomas.

One sad note of the conference was the absence of Colorado's Governor Ed Johnson, who had planned to take part in the conference, but was victim of a heart attack the day before the conference opened. Other speakers at luncheon and dinner events who did make it were Frederick Rohrman, executive director of the Engineering Experiment Station at the University of Colorado; Deputy Mayor Dick Batterton, of Denver; and William R. Wright who described his experiences as member of a State Department mission to Poland.

New Technical Information

The program committee, headed by Dean H.T. Person, provided a variety of new information at the various sessions. One session, devoted to evaporation, climatic data and consumptive use of irrigation water, featured speakers Harry F. Blaney, of Los Angeles, George H. Hargreaves, from Haiti, and R. D. Goodrich, whose office is at Grand Junction, Colo. The economists put on another session, related to cost allocation, evaluation of benefits and economic justification. Taking part were N. R. Bennett, of the Project Development Division of the Bureau, Earl Fogarty of the Economic Resources Branch, and Jewell I. Rasmussen, professor of economics at the University of Utah.

An unusual opportunity was presented for discussion by all in attendance by a panel discussion on drainage investigation. Charles R. Maierhofer was moderator for this panel, which featured a paper by William W. Donnan, of the U.S. Department of Agriculture, and panel members George Bradshaw, K. E. Anderson, E. W. Elliott and John Sutton.

With general plans supervised by Andrew P. Rollins, chairman of the Division, and his executive committee, local arrangements were carried out by S. Mark Davidson, of the Colorado Section, general chairman, and a large committee. Section President Herbert E. Prater also provided for the entertainment of the many wives attending by appointment of a women's committee headed by Mrs. Carl R. Wilder.

Uniform Price Set for "Transactions" Reprints

Reprints of individual papers from current and past volumes of the Society's "Transactions" will now be sold at a uniform price of $1 a copy, regardless of their length or date of issue. The only exceptions are the symposiums, which are uniformly $2 a copy. Members of ASCE will receive the customary 50 percent discount. Prices for quantity orders will be supplied on request.

This system replaces the former reprint price list, in which prices varied. The prices of all other ASCE publications remain the same. The custom of supplying authors with complimentary reprints will be continued.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

"Slow down toll road programs," O. T. Banton, legislative writer for the Lindsay-Schaub newspapers, told a joint meeting of the **Central Illinois Section** and the local chapter of the Illinois Society of Professional Engineers, held in Decatur in September. In the leading talk Mr. Banton discussed the toll road situation—its magnitude, its cost, and possible effects of the President's Highway Program. He also described the toll road system that is being planned for Illinois.

Cincinnati's downtown parking problem received a thorough airing at the **Cincinnati Section's** Ladies' Night on October 5. Prof. Cornelius Wandmacher, of the University of Cincinnati, moderated a panel of speakers consisting of George W. Bowie, city director of public utilities and traffic; P. M. Linscott, of De Leuw, Cather & Co., Chicago consultants; and Harry C. O'Brien, of W. E. Hutton & Co., Cincinnati investment brokers. One of the city's leading ladies, Vice Mayor Dorothy N. Dolbey gave the coffee talk, which was entitled "You and Your Community."

A trip to the East Hartford sewage treatment plant was on the agenda for the **Connecticut Section's** October meeting. Construction and operating features were explained by Earl Howard, senior assistant design engineer of the Metropolitan District's Bureau of Public Works, at the dinner meeting following the inspection tour.

Recent **Duluth Section** meeting programs have featured a dinner at the 515th Air Defense Group Base, where the various facilities were inspected, and the showing of a film on the Coast Guard's duties and responsibilities in the Twin Port area.

Secondary school preparation for engineering training was up for study at the first fall meeting of the **Central River Valley Branch** of the **Georgia Section**—a joint dinner meeting with the South Carolina Society of Engineers. The mathematics and science faculties of the secondary schools in the area were well represented in the attendance of 118. The need for careful planning to assure an adequate supply of high school science teachers was emphasized by Robert L. Sumwalt, dean of the University of South Carolina School of Engineering, in one of two leading talks. The other talk—given by A. D. Day, of the E. I. du Pont de Nemours & Co. Engineering Department and field project manager of the Savannah River Plant—stressed the interest of industry in the development of technical personnel. Mr. Day said that while industry has great need for technicians, "it needs well-rounded engineers considerably more. Engineering positions today call for versatile men—men able to think clearly and logically . . ., men who can express themselves concisely and fluently . . ., men who understand not only the behavior of machines and metals under varying conditions, but the behavior of humans as well."

The effect of atomic bomb explosions on structures was described at the **Kansas Section's** September meeting by Ben Park, of Buildex, Inc., Ottawa, Kans., an eye-witness to the recent tests in Nevada. Colored films made Mr. Park's talk graphic.

The **Maine Section's New Hamshire Branch** sponsored a good meeting at the Portsmouth Air Force Base late in August. Robert Johnson, member of the Branch and resident engineer for the Corps of Engineers, outlined important construction features of the base and then took the group of sixty engineers on a tour of the high spots. Of special interest were the double cantilever hangar, the 11,300-ft runway, and the 200-acre parking apron consisting of a 14-in. concrete

ASCE MEMBERSHIP AS OF OCTOBER 8, 1955

Members	9,017
Associate Members	11,549
Junior Members	17,577
Affiliates	70
Honorary Members	41
Total	38,254
(October 8, 1954	37,462)

Kentucky Section Meets with District 9 Council

Pictured at joint meeting of Kentucky Section and District 9 Council—held in Lexington, Ky., on September 23—are 1955 recipients of Kentucky Section scholarships with Past-President D. V. Terrell (extreme left) and then President-elect Enoch R. Needles (right). Reading, left to right, are Dean Terrell; Donald B. Baldwin, University of Louisville; Bob N. Handcock, University of Louisville; G. R. Watkins, president of Kentucky Section; James L. Heaberlin, University of Kentucky; Aubrey D. May, University of Kentucky; and Mr. Needles. In the leading talk, entitled "The Civil Engineer's Position in Society," Mr. Needles stressed the necessity for good relationship with one's fellowmen and the opportunity the profession offers to serve society. A certificate of life membership was presented to J. Frank Grimes during the joint session.

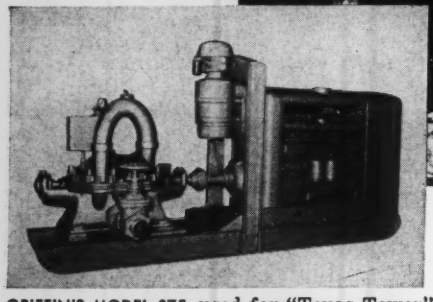
Griffin pumps used to install "Texas

Six heavy-duty, large-volume pressure pumps performed dependably in caisson jetting for first ocean radar platform. Caisson legs were sunk 45 feet below ocean bottom by the contractors —Raymond Concrete Pile Co. and DeLong Corp., a joint venture.

Photo courtesy RAYMOND-DELONG

Photo shows pumps mounted on radar station as the 6,000-ton steel structure is towed down Boston Harbor to Georges Banks, east of Cape Cod. Here, its 3 legs were dropped 56 ft. to the ocean floor and then sunk 45 ft. deeper. Air jacks raised the platform 81 ft. above water level.

1200 G.P.M., 251 P.S.I.



GRIFFIN'S MODEL 275, used for "Texas Tower" jetting. Like all Griffin pumps, it is available for rental as well as purchase. We maintain large pump stocks. Hence, promptness of shipment is a feature of Griffin service.

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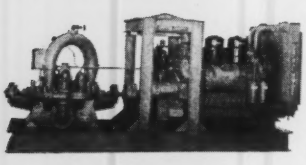
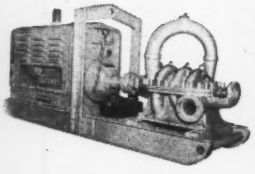
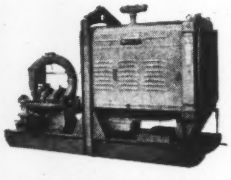


1400 G.P.M., 303 P.S.I.



650 G.P.M., 260 P.S.I.

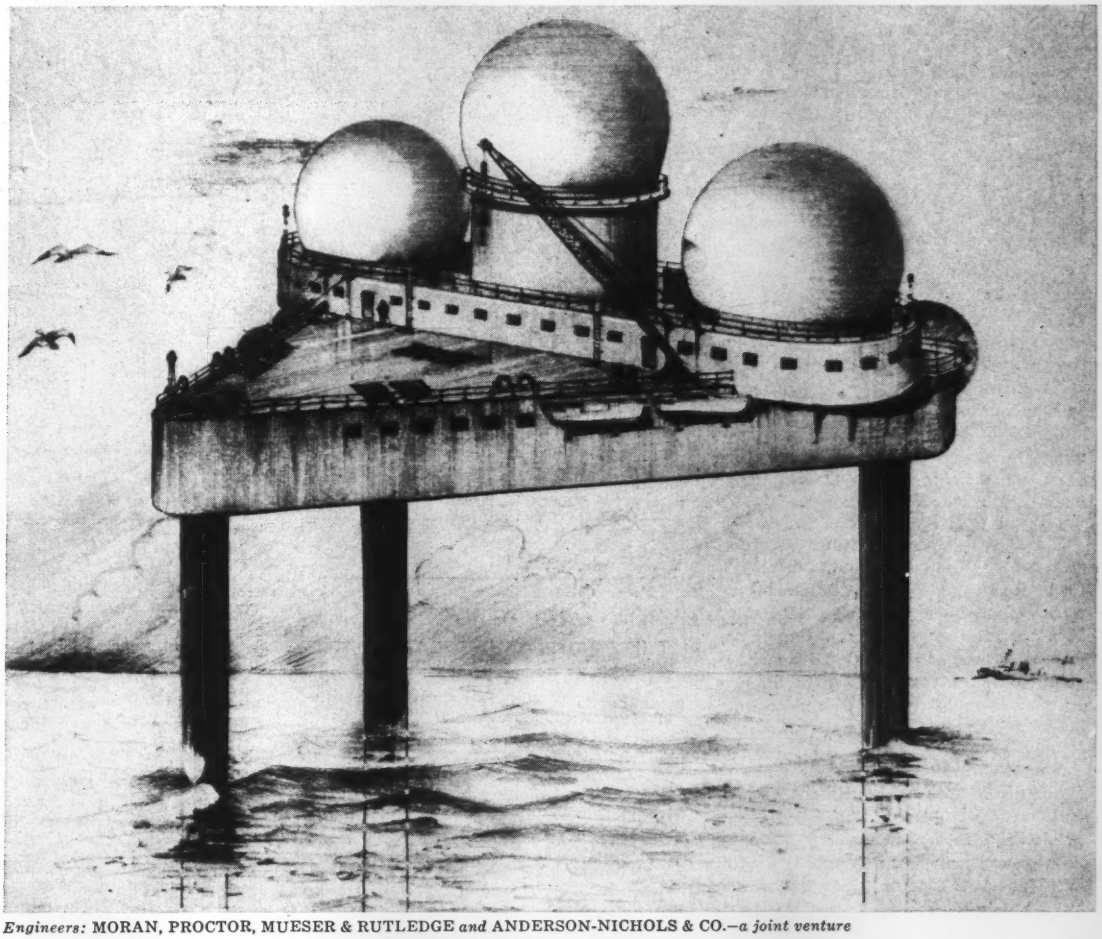


650 G.P.M., 205 P.S.I.

400 G.P.M., 175 P.S.I.

...tower" in complex jetting operation

Drawing courtesy MORAN, PROCTOR, MUESER & RUTLEDGE *and* ANDERSON-NICHOLS



Engineers: MORAN, PROCTOR, MUESER & RUTLEDGE *and* ANDERSON-NICHOLS & CO.—*a joint venture*
Contractors: RAYMOND CONCRETE PILE CO.-DELONG CORP.—*a joint venture*

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Water was furnished by 3 vertical turbine pumps, with total capacity of 6,900 G.P.M., at 165 ft. T.D.H.

All pumps were powered by G.M. Diesel Engines. Jetting was handled with a single jet more than 200 ft. long, equipped with multiple nozzles at the tip.

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slab upon a subgrade compacted by a 200-ton roller.

Colored slides of the process of constructing and anchoring a Texas Tower as a radar station in the Atlantic off Cape Cod were shown to 250 members of the **Metropolitan Section** at its first meeting of the new season. The speakers were Comdr. J. J. Albers, naval officer in charge, and J. Bush, project manager for the contractor, Raymond-DeLong. New **Junior Branch** officers are Martin Kapp, president; Joseph Ward and Louis Cappozoli, vice-presidents; Harry Rode, Jr., secretary; and Milton Alpern, treasurer.

The stratigraphy of the subsoil underlying Mexico City and the problems involved in erecting heavy structures on it were outlined at the **Mexico Section's** September meeting by Leonardo Zeevaert, foundation engineering authority and builder of a number of the tallest buildings in Mexico City (the tallest is forty-five stories high). An interesting discussion of bentonite, the Mexican clay, followed Dr. Zeevaert's talk.

The ASCE Code of Ethics was discussed by the **Mid-South Section's Little Rock** and **Vicksburg Branches** at their September meetings. Recently Vicksburg Branch members also made an inspection tour of the R. G. Le Tourneau plant south of the city, where interest centered in construction of the offshore oil-drilling barge the company makes.

The **Nebraska Section** has its first Branch—the **Southwest Branch,** which will meet at McCook, supplementing Section meetings in Omaha and Lincoln. At a recent organizational meeting Paul W. Mousel was elected president of the Branch; Jesse B. Budd, Jr., vice-president; and Roy Boyd, secretary-treasurer.

At the conclusion of its third season of monthly summer luncheon meetings, the **Northeastern Section** reports the success of this type of get-together. Attendance averaged slightly over 100. Speakers this season were Benjamin Fink, director of park engineering for the Metropolitan District Commission; Herbert Fletcher, Jr., of the Fletcher Granite Co., Ephraim A. Brest, of the Mystic River Bridge Authority; and Arthur T. Lyman, commissioner of the Massachusetts Department of Conservation. Junior Member John J. Cusack was in charge of arrangements.

The construction phase of the Dalles Dam was described by David S. Parker, acting district engineer for the **Portland District,** at a recent meeting of the Oregon Section. Subsequently the group visited the project.

San Diego's pier and harbor situation was on the agenda for the **San Diego Section's** September meeting. J. E. Liebmann, harbor engineer, discussed the construction of San Diego's new Tenth Avenue Pier and the problems involved in the type of structure chosen—a marginal-type pier, utilizing a cyclopean concrete quay wall. Milton Hallen, harbor traffic manager, reviewed the economic growth of San Diego Harbor since he took office in 1952. He said that the number of commercial steamships using the harbor is increasing steadily as a result of getting minimum tonnage factors reduced and arbitraries dropped, and that the goal of the department is to have San Diego Harbor designated a terminal harbor with no restrictions whatsoever on cargo.

I. C. Steele, former Director of the Society and well known as an expert on rockfill dams, addressed the **San Francisco Section** on October 18. His subject, "The High Aswan Dam of Egypt," compressed nearly six millenia of Egyptian engineering into an illustrated, one-hour presentation. Mr. Steele has made three trips up the Nile since 1953 as a consultant to the Egyptian Government on the Aswan Dam project, which is expected to be the world's largest rock-fill dam when completed. Honored guests at the dinner meeting for an overflow crowd were Adbel Moneim El-Khedry, consul-general of Egypt for the 26 Western states and Hawaii, and his vice-consul, Abdel Salam Mansour.

Herbert D. Vogel, chairman of the Board of the Tennessee Valley Authority, was guest speaker for the September dinner meeting of the **Tennessee Valley Section's Chattanooga Branch.** General Vogel touched briefly on the engineer's responsibility to his nation, his community, his profession, and to himself.

H. D. Vogel

Coming Events

Arizona—Annual fall meeting in conjunction with the Seventh Annual Joint Engineers Meeting scheduled for November 18 and 19.

Georgia—Annual meeting featuring technical sessions, luncheon and dinner, on December 3.

Intermountain—Meeting at Peelers Cafe, 3786 Highland Drive, Salt Lake City, Utah, November 18, 6:30 p.m.

Kansas—Meeting in Lawrence, Kansas, on November 18.

Kansas City—Two-day hydraulics conference at the Continental Hotel, Kansas City, Mo., November 21 and 22.

Maine—Theme of Annual Highway Conference at the University of Maine, Orono, December 16 and 17, will be Highway Safety and Maintenance. **New Hampshire Branch** highway conference at the University of New Hampshire, Durham, N.H., December 17. Annual meeting of New Hampshire Branch at Concord, November 16.

Metropolitan—Meeting in the auditorium of the Engineering Societies Building, New York, N.Y., November 16, 7:00 p.m. Meeting of Junior Branch in Room 502, Engineering Societies Building, December 7, 7:00 p.m.

Nebraska—Annual student meeting at the University of Nebraska, Lincoln, November 16.

Northeastern—Dinner meeting and social hour at M.I.T. Faculty Club, November 21, 5:30 p.m. Election of nominating committee for Section officers will be held.

Oklahoma—Annual meeting at Norman, Okla., on the morning of November 26.

San Francisco—Dinner meeting of Structural Division at Marconi's Restaurant, 122 Battery Street, San Francisco, November 9, 6:45 p.m. Junior Forum dinner meeting at New Milani's Restaurant, Oakland, on November 15, 6:30 p.m. San Jose Branch will hold its regular meeting on November 15.

Wisconsin—Meeting in Milwaukee on November 22, will feature talk on "Asphalt Products in Road Construction."

Scheduled ASCE Conventions

DALLAS CONVENTION
Dallas, Tex.
Hotel Baker
February 13–17, 1956

KNOXVILLE CONVENTION
Knoxville, Tenn.
University of Tennessee
June 4–8, 1956

PITTSBURGH CONVENTION
Pittsburgh, Pa.
William Penn Hotel
October 15–19, 1956

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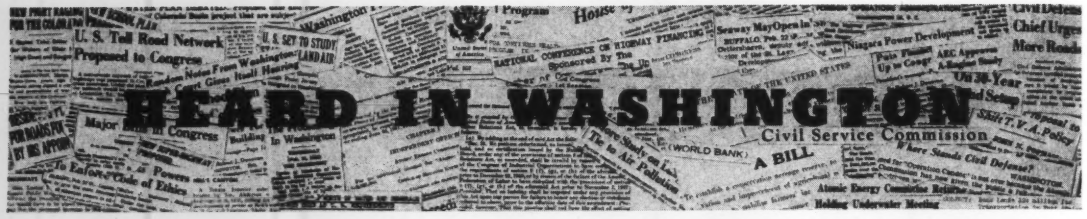

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

The season for conferences and hearings in industry and government is now at hand. These conferences will reveal the outline of things to come and lay a foundation for legislation in the approaching session of Congress. Technology in general and public works construction in particular will get more than ordinary attention.

Hoover Commission Reports

Conferences and hearings on the Hoover Commission Reports will be numerous and important. On October 10 a conference of trade and professional association representatives was held under the auspices of the Chamber of Commerce of the United States, to afford a briefing on some of the reports. Some startling facts were revealed in regard to government real property holdings, paper work management, business undertakings, and lending agencies.

As a realtor, the government owns one-fourth of the acreage of the 48 states and 2.5 billion sq ft of floor space. Government handling of 25 billion pieces of paper costs $4 billion a year. Federal loans, guarantees and insuring activities of 104 "lending agencies" involve $240 billion in "moral" obligations, over and above our $274 billion national debt.

Of 350 recommendations claimed to offer aggregate savings of $5\frac{1}{2}$ billion, 195 can be accomplished by executive order; 155 require congressional action. Executive Department savings of $144 million have already been effected. Bills numbering 230 and covering about 70 topics have already been introduced in Congress. Some conclusions of the Commission are highly controversial, particularly those relating to water resources and power, lending agencies, legal and medical services. The Commission was an arm of Congress, although its findings relate to the Executive Department. A "Citizens Committee for the Hoover Report" will work for adoption of the recommendations.

Water Policy

A National Conference on Water Policy, sponsored by the Chamber of Commerce of the United States with the cooperation of Engineers Joint Council, will be held in St. Louis on January 24 and 25 to discuss this most controversial topic and the Hoover Commission Report on the subject. Some ASCE members will be active in this program. Congressional subcommittee hearings have already been held in regard to flood-control proposals. Recent floods will have important repercussions on flood-control legislation in the next session.

Education

A White House Conference on Education will be held in Washington beginning November 28, following a series of state conferences. Three topics of interest to engineers will be considered. What skills and fields need to be emphasized, such as pre-engineering science? How can good teachers be obtained, especially in science? What are the needs for school construction? Engineers Joint Council representatives will take part in the National Conference; they have already participated in some of the state gatherings.

Findings of the Conference will have a bearing on the now pending legislation for a $1.6 billion program of grants-in-aid for school construction.

Highways and Public Works

The highway situation will be thoroughly aired at the January meeting of the American Road Builders Association and several other group conferences yet to be announced. The problem remains unchanged. Roads are badly needed. How can we pay for all we want? How can we persuade areas not predominantly concerned with the Interstate System to support that desperately needed system without running the total bill to staggering proportions? This problem gets away somewhat from the field of technology and into that of public finance. All the conferences will try to come up with some answers—and to lay the groundwork for the most vigorous representation before Congress.

A National Conference on Public Works will be held in Washington on January 16 and 17 under the joint auspices of ASCE and the American Institute of Architects in cooperation with the Chamber of Commerce of the United States. This will serve to inform the professions and the construction industry on the programs and proposals of the agencies dealing with public works planning and programming, with grants-in-aid, with plans to combat stream and air pollution and many other aspects of the government's activities in the field of public works.

Urban Redevelopment

Urban redevelopment is an undertaking intimately related to the field of local public works and city planning. Not only were additional funds and authority given to the Urban Renewal Administration of the Housing and Home Finance Agency in the recent session of Congress, but a revolutionary bill was introduced (H.R. 1864) which would establish in the Executive Branch a new Cabinet Department. It would be known as the Department of Urbiculture and would deal with the social, economic, and civic problems arising from improper use of city land. It would absorb the existing Housing and Home Finance Agency and presumably perform for cities many diverse functions which the Department of Agriculture performs for the rural areas. No hearings have been held, but it is a subject that will bring forth some lively discussions.

Several voluntary organizations have been formed to promote the rehabilitation of blighted urban areas. The Chamber of Commerce of the United States is issuing an "Urban Development Guidebook.

Washington, D. C.
October 20, 1955

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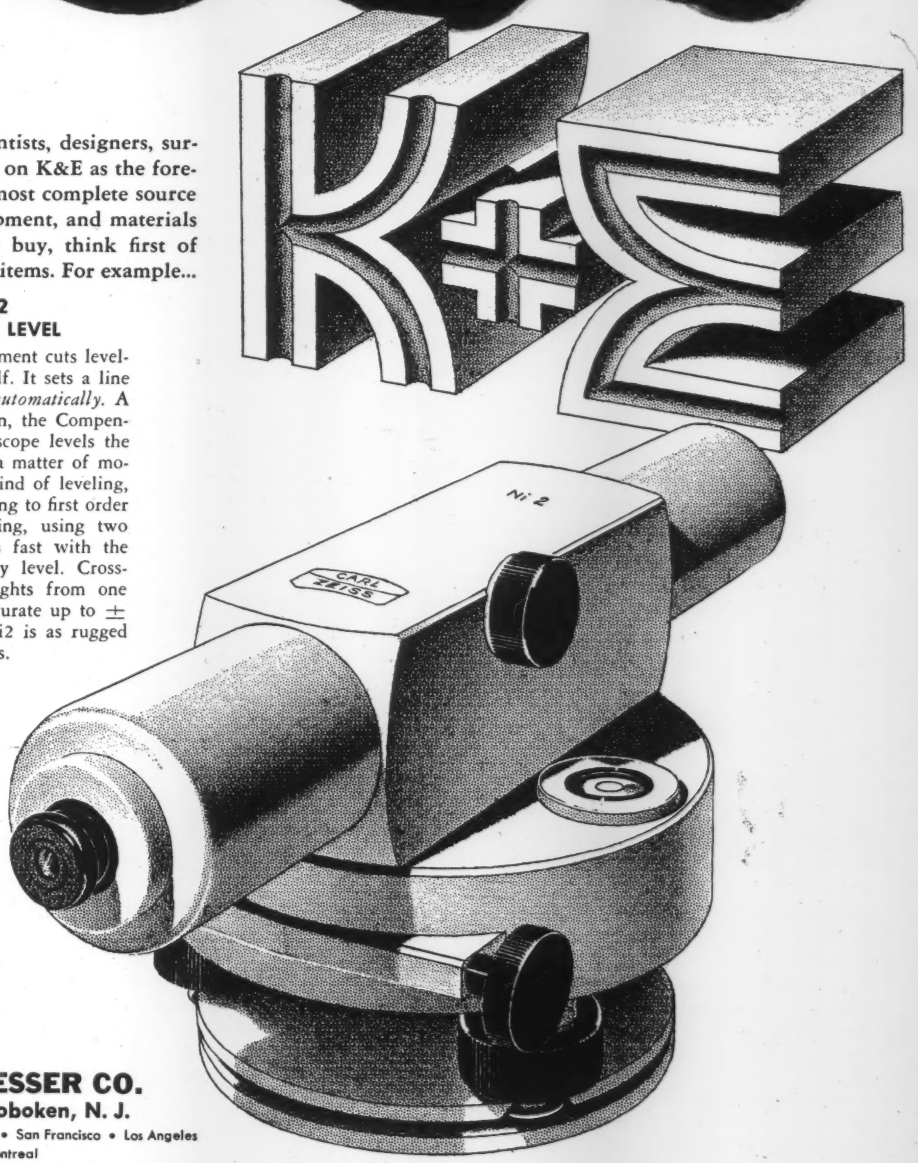

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NEWS BRIEFS . . .

Work on Third Tube of Lincoln Tunnel Advanced

Construction of the third tube of the Lincoln Tunnel was advanced across the New York-New Jersey state line on October 5, as sand hogs placed a final ton-and-a-half cast-iron segment to close a tunnel ring at a point 3,832 ft from the Weehawken, N.J., entrance of the 8,000-ft-long facility. On the New York side, a 1,750-ft section extending from the ventilation shaft to the exit plaza has also been completed.

Port Authority Chairman Donald V. Lowe signaled the lowering of the tunnel segment into the 60-ft-deep Weehawken construction shaft. Loaded on a rail flat car, the segment then moved through a completed section of the tube under normal pressure to the concrete bulkhead leading to the compressed air section of the project.

The two-lane roadway is being assembled, ring by ring, by 200 sand hogs working under compressed air 97 ft below the surface of the river. They work behind a giant shield, which "cooky-cuts" its way in 32-in. shoves to connect the two states under the Hudson River. Production has reached a point where fourteen rings are placed a day.

Ground was broken for the $100,000,000 third tube on September 25, 1952. When the facility is completed early in 1957, it will increase the capacity of the Lincoln Tunnel by 50 percent.

AGC Nominates New Officers for 1956

Frank J. Rooney, Miami building contractor, was nominated for 1956 president of the Associated General Contractors, by the Governing and Advisory Boards at their midyear meeting. Lester C. Rogers, M. ASCE, president of Bates & Rogers Construction Corp., Chicago, was nominated for vice-president. Mr. Rooney, who is currently vice-president of AGC, will succeed George C. Koss, of Des Moines, Iowa. The new officers will be installed at the concluding session of the AGC's 37th annual convention in New York, February 13-16.

Managing Director H. E. Foreman, in presenting his report of AGC activities since the last convention in March, said that the prospects are for a continued volume of construction at record levels. However, he warned that general contractors now face, and will continue to face, serious problems in the future in carrying out their work.

Haines-Fairbanks Pipeline Project Is Completed

An important unit in our defense system in Alaska, the recently completed $40,000,000 Haines-Fairbanks pipeline project (including three major pumping stations) was turned over to the army in formal dedication ceremonies at Haines, Alaska, on October 12. Though the 626-mile pipeline crosses some of the bleakest and most difficult terrain on the continent, it was laid in one season except for a 1,000-ft gap in the Yukon Territory that had to wait for the winter freeze-up. Here the installation crosses a mountain-fed tributary of Kluane Lake in the Yukon Territory, one of many treacherous and meandering streams that must be traversed. To provide protection against yearly floods, the crossing utilizes H-frames driven to 55-ft penetration in the stream bed. The project was constructed under supervision of the Alaska District of the Corps of Engineers by a combine consisting of Williams Brothers Co., Tulsa, Okla., the Marwell Construction Co., Ltd., Vancouver, B.C., and the McLaughlin Construction Co., Great Falls, Mont.

New Industrial Park For Philadelphia Area

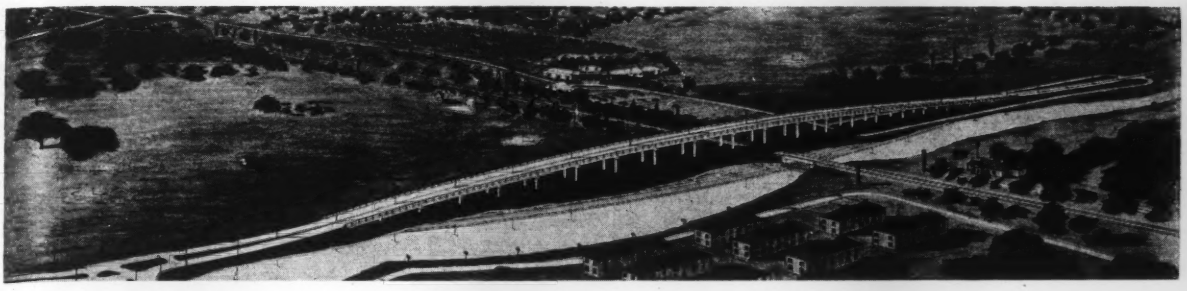
A complete package plan of financing, engineering, and construction services is offered industries and organizations wishing to settle in the Philadelphia area by a new development called Fort Washington Park. Described as "a suburban counterpart of Rockefeller Center," the industrial park has begun operation on an initial 300-acre tract only 25 minutes from Philadelphia's City Hall. It will provide and maintain complete year-round recreation facilities, and has the transport advantage of being located close to the Pennsylvania Turnpike. The project is financed by a Philadelphia group headed by Seltzer Brothers.

Information is available from the Fort Washington Corp., Fort Washington, Pa.

Army Awards Contract For Arctic Radar Bases

A joint venture consisting of two New York contracting companies—Johnson, Drake & Piper International Corp. and Merritt-Chapman & Scott Corp.—has received a Corps of Engineers' contract in excess of $11,000,000 for construction of six advance-warning radar bases in Newfoundland and Labrador, according to an announcement from the Eastern Ocean District. The contract includes construction of access roads, communication facilities, and necessary utilities.

New Orleans Builds Prestressed Concrete Overpass



City of New Orleans is constructing a prestressed concrete structure, a 2,450-ft overpass, which will carry Wisner Drive over the main line tracks of the New Orleans Terminal Co., in City Park. The structure, shown here in artist's rendering, is one of the final projects in the city's current Union Passenger Terminal and grade-crossing elimination program. Consulting engineers for the job are G. A. Heft & Co., New Orleans, and the contractor is the Keller Construction Corp. The structure carries two 24-ft-wide roadways, separated by a 4-ft median strip. The prestressed concrete deck spans will be 60 ft long, except for one 42-ft span over the railroad tracks. The deck will be carried on eight precast, prestressed concrete girders per span, spaced at 6-ft 8-in. centers. The girders will rest on reinforced concrete piers supported by concrete-filled steel-shelled piles approximately 90 ft long. The project will cost about $950,000, and is scheduled for completion next June.

Prestressed Concrete Congress Meets in Amsterdam

Over a thousand registrants from 35 countries attended the meetings of the Second Prestressed Concrete Congress held in Amsterdam August 29–September 2. This attendance included about 700 active members of the International Federation of Prestressed Concrete. For the first meeting in many years, engineers from the U.S.S.R., Poland, and Czechoslovakia attended and took active part in the technical meetings and social affairs. There were thirteen men from the U.S.S.R., plus eight from other Communist countries. The United States was represented by eight engineers, and the Western Hemisphere by only a few more. Germany with 97 and Great Britain with 138 were the largest foreign representations. As far as language barriers permitted, there were extremely friendly relations among all the participants, the Russians being most amiable and interested in conditions in other countries and quite willing to answer all questions.

The technical program concerned itself with three subjects (two of them subdivided), on which papers had been submitted and analyzed by a general reporter, and two communications concerning general items not subject to discussion. The subjects were:

1(*a*) Function of grouting and anchorages in the behavior of prestressed elements, on which eight papers were submitted and summarized by Beato Kelopuu, M. ASCE, of Helsinki, Finland.

1(*b*) Experience and problems concerning the manufacture and use of steel for prestressing, on which six papers were submitted and summarized by A.S.G. Bruggeling of Holland.

2. Progress of precast prestressed work in the factory and on the assembling, by prestressing on the site, of precast units, on which 13 papers were submitted and summarized by D. H. New of England.

As a supplement to discussion of these subjects, a number of films illustrating progress and methods in the various countries were shown evenings. Two of the films, made in Moscow, show an extremely large-scale production of precast concrete homes. They are available for showing in the United States. The Russian delegates advised that arrangements can be made with their New York agency for obtaining copies, and also said that both films were being presented to the Dutch hosts as a gift and that they could easily have copies made. The U.S.S.R. reported that plants are now available for a production of 180,000 cu m (about 200,000 cu yd) of prestressed precast items per year, plants being in units of 20,000 to 30,000 cu m each. The plan for 1955–1956 is to build 200 precasting yards, of 10,000,000 cu m per year (of which some 25 percent will be prestressed with 5-mm wire), and to concentrate on a limited number of standardized units for residential and industrial buildings.

3(*a*) Moment distribution in statically indeterminate prestressed structures, beyond the elastic phase. Four papers on this subject—summarized by Y. Guyon of France—were followed by some ten discussions of a highly theoretical nature.

3(*b*) Influence of plasticity on the strength and instability of prestressed thin shells, on which a paper by A. M. Haas was read by Franco Levi, Italy.

The two following communications were summaries of information gathered from various countries and give completely the present status of each question:

1. Comparative analysis of specifications and practice on prestressed concrete, used in various countries, by A. Paduart of Belgium.

2. The economic advantages of prestressed concrete in various countries, by A. W. Hill of England, with cost comparisons for many projects of prestressed design with others of steel or concrete design.

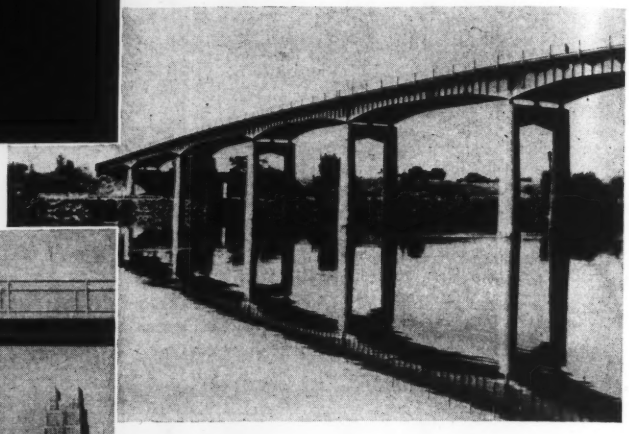
At the opening session, there was a fitting tribute to the work of the late Gustave Magnel, M. ASCE, presented by Edward Torroja, M. ASCE, of Madrid, Spain. In an address on "Prestressed Construction," E. Freyssinet, president of the Federation, emphasized that steel is not the only means of prestressing and that compressions induced by air pressure and other means will become popular some years hence.

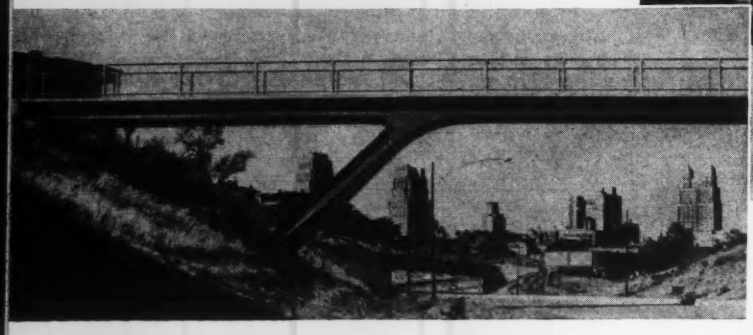
A surprisingly large number of the speakers warned that designs are becoming too theoretical and that the last possible percentage of support value must not be squeezed out. The demands of safety and guarantee against failure must take into consideration the possible variation between field performance and office design. Some very candid discussions were given on "incidents" and the cause of such failures and how to avoid them.

As usual, the very close contact with fellow engineers from the various countries contributed greatly to the value of the Congress. There was a completely relaxed and friendly spirit throughout the entire week, as if international tensions did not exist. Professor Torroja will be the next president of the Congress, which will have its next meeting in 1959, with San Francisco a possible site.

[This write-up is an abstract of a report provided by Jacob Feld, M. ASCE, consulting engineer of New York and ASCE representative to the Congress.]

AISC Awards Prizes for Beautiful Bridges Opened to Traffic in 1954





Top honors in the American Institute of Steel Construction's 27th annual competition for the most beautiful steel bridges in the country opened to traffic in 1954 go to these three structures. Winner in Class I, for bridges with spans of 400 ft or more, is the Missouri River Bridge (upper left photo), Kansas City, Mo. Honored because it "offers an unusual contrast to the more familiar form of suspension bridge and represents a pleasantly economical use of material for the work to be done," the structure was designed by Howard, Needles, Tammen & Bergendoff and fabricated by the American Bridge Division of U. S. Steel. It is owned by Jackson and Clay counties, Missouri. In Class II (for bridges with spans under 400 ft and costing over $500,000), the award goes to the Little Chute Bridge (right-hand photo) over the Fox River, Outagamie County, Wisconsin, which was designed by the Bridge Section of the Wisconsin State Highway Commission, and fabricated by the Bethlehem Steel Co. The State of Wisconsin is the owner. In Class III (for bridges with fixed spans under 400 ft and costing less than $500,000) the winner is Garrison School Pedestrian Bridge (lower left photo) over the Paseo at Kansas City, another Howard, Needles, Tammen & Bergendoff structure. The fabricator is the Kansas City Structural Steel Co., and the owner Jackson and Clay counties.

Engineers Needed in Iraq

The Government of Iraq has openings for several architectural and structural engineers and surveyors for a two-year engagement at salaries up to $700 a month. Further information may be obtained from the Embassy of Iraq, 2135 Wyoming Ave., N. W., Washington, D. C.

Ohio Valley Has Enormous Underground Water Stores

More than a trillion gallons of water is stored in the sand and gravel fill of the Ohio Valley in Kentucky, according to a recent report of the U.S. Geological Survey. The report, which was prepared in cooperation with the Agricultural and Industrial Development Board of Kentucky, describes the old deep bedrock channel of the Ohio River and the alluvial deposits that fill it along the section of the valley bordering the state. The coarse-grained alluvial deposits are permeable and form a groundwater reservoir that ranks as one of the most important in the United States. Because water moves from the river into the alluvium during periods of high river stage and whenever pumping from wells lowers the adjacent water table below river level, the supply is virtually inexhaustible as long as there is water in the river.

One series of cooperative works describing the availability of groundwater in the state, the report will be published as a Survey hydrologic atlas. Pending publication, manuscript copies are available for study in Geological Survey offices in Louisville, Ky., and Washington, D.C., and at the office of the Agricultural and Industrial Development Board of Kentucky, New Capitol Annex, Frankfort, Ky.

AEC to Build Engineering Test Reactor in Idaho

Construction of an Engineering Test Reactor at the National Reactor Testing Station in Idaho has been authorized by the Atomic Energy Commission. The project will provide the AEC with radiation facilities needed by early 1957 for military and civilian nuclear power development programs. The estimated cost of the reactor will be about $15,000,000. The architect-engineer is Kaiser Engineers, Inc., Oakdale, Calif.

New York Firm Receives Spanish Base Contract

The largest construction contract for the building of United States-financed military facilities in Spain has been awarded to the Corbetta Construction Co., of New York, in a joint venture with a Spanish firm, Construccione Civiles, S.A., of Spain. The $17,372,000 low-bid contract calls for the construction in three years of a breakwater-protected seaport and fuel-supply base in the windswept harbor of Rota on the Atlantic Coast near Cadiz in southwestern Spain.

Regarded as the key facility in the whole Spanish airbase and military construction program now under way, the project includes a Navy airstrip a few miles inland, which will be built under a separate contract. In addition to being the principal supply point for fuels and lubricants for our chain of air bases in Spain, it will be the only U.S. Navy installation in Europe where aircraft carriers can be fueled and carrier-based planes landed and serviced.

A combine of three United States construction companies—Brown & Root, Raymond Concrete Pile Co., and the Walsh Construction Co.—is the prime management contractor appointed by the Navy to direct the construction of all our military installations in Spain.

Edmund Claxton Heads Building Research Group

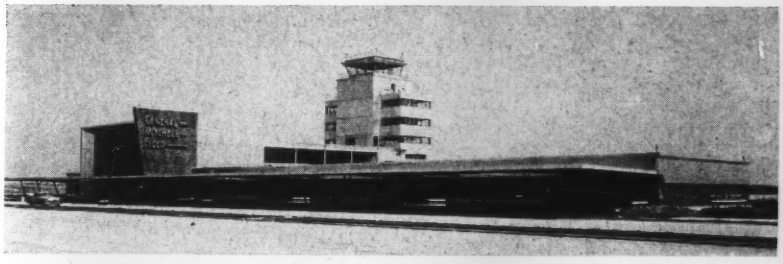
Edmund Claxton, director of research for the Armstrong Cork Co., is the new president of the Building Research Institute, succeeding Fred M. Hauserman, who was the Institute's second president. William Muirhead, president of the William Muirhead Construction Co., Durham, N.C., is the new vice-president. W. H. Scheick continues as executive director.

First Stage of Cyprus Power Supply Completed

As part of a ten-year program of development begun in 1946, the Government of Cyprus has completed the first stage of a 70,000-kw generating station at Dhekelia in the southeastern part of the island. A steel-frame structure of the semi-outdoors type, the recently installed unit has a generating capacity of 28,000 kw. Its estimated cost is about $6,000,000. When the entire project is completed, it will provide power for the whole island. Previously only a few municipalities and mining companies and similar agencies (with private generating plants) have had power.

The consulting engineers on the project were Preece, Cardew & Rider, and the civil engineering work was carried out by Scott & Wilson, Kirkpatrick & Partners.

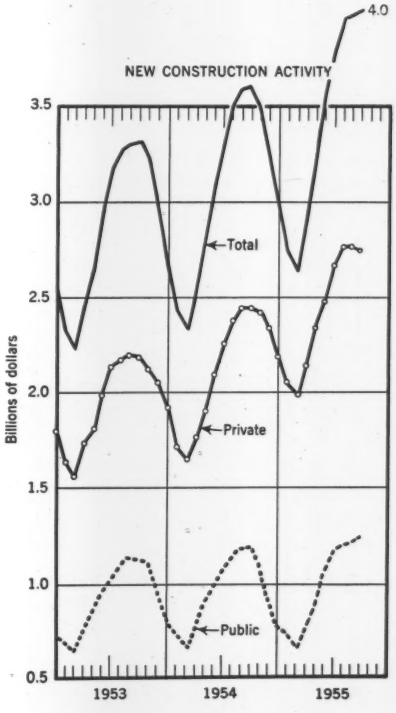
Milwaukee Airport Features Lightweight Construction



The terminal building in Milwaukee County's new $3,250,000 General Mitchell Field, which began operation this summer, is constructed primarily of lightweight Fenestra steel panels selected because the low, marshy building site precluded the use of very heavy structures. Insulated with Fiberglas, the panels are strong as well as light and provide a barrier against heat loss equivalent to a 16-in. masonry wall. In the roof of the 1,220-ft terminal building, they provide an acoustical ceiling and also replace the joist system, serving as the structural roof over which the insulation and built-up roof is applied. Finger-type construction facilitates entry into and exit from the structure. The terminal was designed to handle ten times its present traffic of 250 flights daily, and the physical plant was designed for 100 percent expansion.

September Construction Continues to Break Records

New construction activity increased to an all-time high of $4 billion in September, rounding out the most active quarter on record for the construction industry, according to preliminary joint estimates of the U.S. Departments of Commerce and Labor. The value of new work put in place during the month brought the total for the third quarter to $11.9 billion, 9 percent more than in the July-September 1954 period. After adjustment for seasonal factors, new construction activity in the third quarter of 1955 was at an annual rate of $41.8 billion, compared with actual outlays of $37.6 billion in 1954.



Commercial building continued at a record-breaking rate in September, exceeding the $300 million mark for the first time. Construction of churches and private industrial facilities was also greater in September than in any previous month. Although private residential building continued to edge off, the September volume was sufficient to bring the third-quarter total to a new quarterly record of nearly $4.5 billion.

State and local public construction continued to expand in September to a new high, new monthly peaks being recorded for public school building and highway construction. Sewer and water facility work exceeded $100 million for the third consecutive month. The value of work installed for these three important types of public works accounted for two-thirds of the total public-construction expenditures in the quarter just ended. Federal construction activity in September remained well under the levels of a year ago, except for military facilities for which outlays have been approaching the post-war peak of 1952.

September construction activity, at all-time monthly high of $4 billion, ups new construction for third quarter of 1955 to annual rate of $41.8 billion.

Oregon City Passenger Elevator Meets Difficult Site Requirements

In designing a new municipal passenger elevator for Oregon City to replace an existing structure at approximately the same site, the engineers had to find a location for the new shaft that would reduce rock excavation to a minimum while leaving the street below clear for automobile traffic. A circular, or mushroom-shaped structure, located close to the cliff side of the railroad and just clearing the corners of the elevator cab, was decided upon as the most economical design, since it minimized rock excavation. This design also permitted locating the elevator as near the tracks as possible and utilizing a short underpass to the street. The observation platform was designed to project from the central shaft—a provision that eliminated the cost of carrying this much expanded floor area for the full height of the shaft.

The project was also unique because of the unusual amount of coordination and cooperation with other agencies required. Several main Western Union telegraph lines had to be relocated before blasting could begin. In addition, all blasting had to be timed to fit into Southern Pacific Railroad train schedules. The main water supply line to the city of West Linn across the river had to be cut and relocated to accommodate the underpass. Though a quick-setting concrete mix was used for the underpass sections, the railroad had to cooperate by slowing trains at the construction site, rerouting them over side tracks, rearranging safety signal equipment, etc. Furthermore, one of the requirements of the job was that the 2,000 to 4,000 persons using the old elevator daily should not be without elevator service for more than fourteen days—a difficult stipulation since the new shaft was built through the bridge of the old structure. (As things worked out, more than twenty days was allowed for the changeover.)

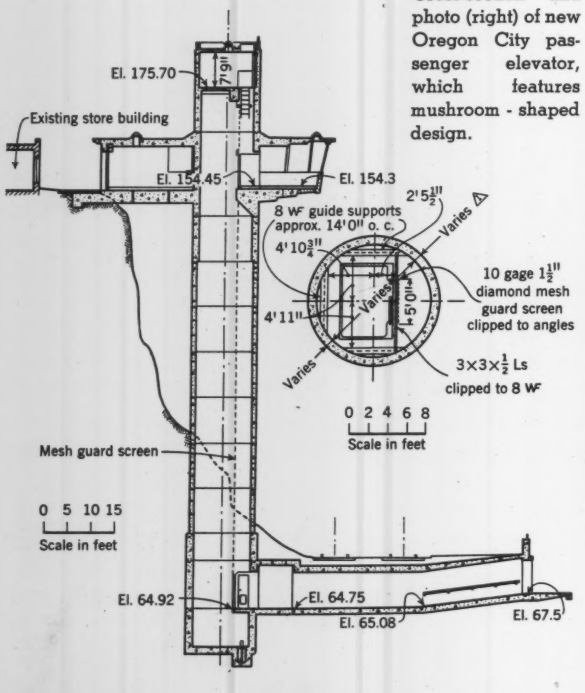
The outside diameter of the shaft is 13 ft 9 in. The cantilever floor of the "mushroom" as well as its roof are elliptical in plan, with maximum projections beyond the face of the shaft of 13 and 16 ft, respectively. It can easily be seen that the center of gravity of the whole structure is very high. In order to lower it and to reduce earthquake effects, the total upper portion of the tower (above El. 139.0), including the "mushroom," was poured of lightweight Haydite concrete, and everything below that elevation was made of regular gravel concrete. Starting from the bottom of the pit floor (El. 55.0), 26 ft of the shaft were poured against the rock having a nominal wall thickness of 16 in. This portion of the structure is considered to be fully restrained in the rock, in three directions at least, and all wind and earthquake forces were assigned to it. The next 58 ft, still gravel concrete, were poured in six lifts with a structural depth of 10 in. plus $1^1/_2$ to form architectural flutes, followed by 46.45 ft of lightweight concrete.

In order to take care of the cantilever moment and especially the considerable shear forces induced by the cantilever in the barrel walls, the structural depth of the latter was increased to 14 in., starting with the first pour of the lightweight concrete up to the machine floor. The wall in the uppermost 9.75 ft of the shaft has a structural depth of 8 in. The foundations of the main shaft, although primarily in hard rock, at one point went through a 3-ft-thick layer of coal-like material before reaching firm support on more solid rock below.

The regular concrete was designed for 3,500-psi compressive strength at 28 days. Average test cylinder strength at this age showed 4,800 psi on a six-sack mix. Lightweight "Haydite" concrete was designed for 3,300-psi compressive strength at 28 days. Average test cylinder strength at this age showed 3,500-psi on a $6^1/_2$-sack mix.

Total height of the tower was 129 ft, and elevator lift height was 90 ft. The structure is made entirely of reinforced concrete and is fireproof throughout. Architectural features include a granite entrance motif; glazed mosaic ceramic wall tile at the underpass on an elastic thin setting base to eliminate cracks from vibration; cork acoustical tile ceiling in the underpass for sound deadening and to prevent condensation; and aluminum window sash having slip joints to allow for differential deflection of roof and floor slab and with special ventilation and window-washing features. Ornamental metal work is of alumilited aluminum. Total cost of the project, including architectural and engineering fees, was $175,000.

Engineering was performed by the Portland firm of Stevens & Thompson. Architectural design was by Gordon E. Trapp. Structural engineering design was under the direction of Ervin A. Soot, M. ASCE. Chris Strohmeyer, city engineer of Oregon City, was the resident supervisor. Contractors were James and Yost, Portland.



Cross-section and photo (right) of new Oregon City passenger elevator, which features mushroom - shaped design.

There's a Bolted Steel Frame in This New Building in Florida

Here's a structure that is winning much favorable comment. It's the home office building of Independent Life and Accident Insurance Company, Jacksonville. It is 18 stories high, and L-shaped, and is topped by an attractive illuminated pylon of stainless steel.

The building, covering 16,800 sq ft of ground area, is faced with Indiana limestone, trimmed with glazed brick. Emerald-pearl Swedish granite is used for the first-floor facing. Mechanical equipment is grouped on the upper floors, an innovation in the Southeast for buildings of this type. The structural members making up the 1500-ton steel framework are bolted together with thousands of Bethlehem High-Strength Bolts.

Bethlehem High-Strength Bolts have come to be widely used in joining structural members. They provide permanently tight joints and make possible a saving in erection time. They are particularly desirable for construction in hospital and school zones, as the pneumatic wrench used in tightening the nuts is less noisy than a riveting gun.

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Bethlehem High-Strength Bolts join structural members of 1500-ton framework for Independent Life and Accident Insurance Company building, Jacksonville. Steel fabrication and erection by Bethlehem. *Architects:* Kemp, Bunch & Jackson; *General Contractors:* S. S. Jacobs Company; *Consulting Structural Engineer:* J. L. McCollough.

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Plastic Design in Structural Steel Studied at Joint Conference

A special course in "Plastic Design in Structural Steel" was held on the Lehigh University campus at Bethlehem, Pa., September 7–15, under sponsorship of the University and the American Institute of Steel Construction in cooperation with the Structural and Engineering Mechanics divisions of ASCE and the American Society for Engineering Education. The attendance of some 300 engineering educators and practicing engineers represented 41 states, the District of Columbia, Canada, Puerto Rico, and Sweden.

A total of 14 lectures was presented by Lynn S. Beedle, A.M. ASCE, Bruno Thurlimann, and Robert L. Ketter, J.M. ASCE, members of the Lehigh faculty who have devoted much of their time in recent years to research in the field. The course offered comprehensive coverage of the subject, from fundamental concepts to application to design problems. Both the equilibrium and mechanism methods of plastic analysis were explained, with illustrations showing how simply the ultimate strength of many-times-redundant continuous steel structures can be predicted. The question of stability was thoroughly explored, and (based upon the results of extended experimental research at the university) rules that provide adequate safety against premature buckling were given. Also covered were the calculation of deflections in the inelastic range and the design of connections.

Laboratory demonstrations included the loading of a 20-ft, 12 WF 36 beam, continuous over three supports, to show the increased carrying capacity through redistribution of moment; the loading of a 15-ft, 14 WF 38 simply supported beam at its third point, to demonstrate how rotation capacity is affected by lateral buckling; and the eccentric loading of a beam-column, to show the effect of axial force on plastic moment. The ultimate strength and rotation capacity of a typical square corner connection, made from equal lengths of 30 WF 108 sections, were observed when the free ends of the joined members were loaded transversely in compression at an angle of 45 deg to their longitudinal axis.

On the last day of the course a typical 15-ft-high gabled portal frame, with a column spacing of 40 ft, was tested under a combination of vertical and horizontal loads simulating actual service conditions. All the tests clearly showed the remarkable accuracy with which ultimate strength and inelastic behavior are predicted by plastic analysis. Contrasted with this excellent agreement between test and analysis was the marked discrepancy between the loads at which initial yielding occurred (as evidenced by the flaking of whitewash) and those predicted by the coupon yield-point strength of the members.

Since ordinary mild structural steel has a marked ability to deform plastically after the yield-point stress has been reached, thereby permitting a continuous structure to draw upon the reserve strength of the lesser stressed portions upon the occurrence of a substantial overload, the ultimate in this overload is reached only when sufficient points of elastic yielding (plastic hinges) occur to transform the frame into a "mechanism." It was the opinion of the Lehigh group that plastic design, for the present at least, would be applied chiefly to continuous frame buildings of one and two-story height, although it could serve a useful purpose in the design of floor beams in tier buildings whose columns might still be designed elastically. Substantial savings in design time, and generally some saving in the use of main material, can be realized by this more rational utilization of the real strength of structural steel, without radical change in present fabrication and erection practices.

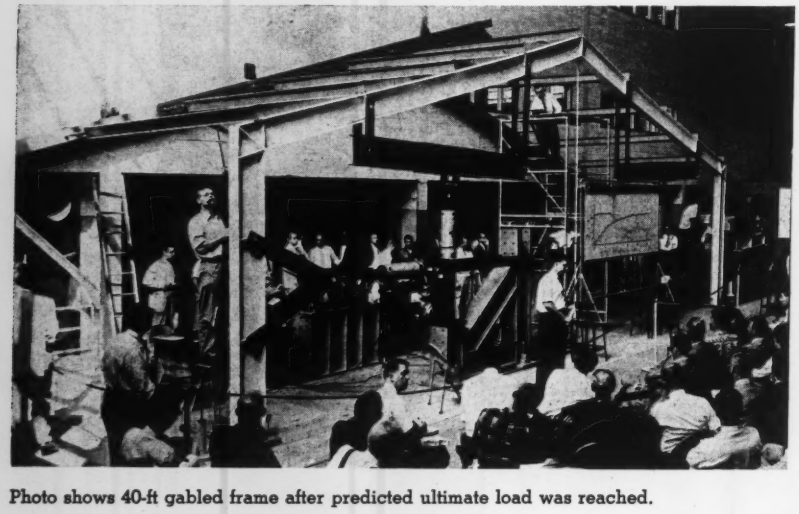

Photo shows 40-ft gabled frame after predicted ultimate load was reached.

NUCLEAR NOTES

XV—Introduction to Shielding

At the request of the Committee on Sanitary Engineering Aspects of Nuclear Energy, R. H. Ritchie has prepared this installment of "Nuclear Notes," dealing with shielding. Mr. Ritchie is in the Health Physics Division of the Oak Ridge National Laboratory, Oak Ridge, Tenn. Conrad P. Straub, of the Oak Ridge Laboratory, heads the committee, which also includes Earnest F. Gloyna, A. E. Gorman, Prof. Warren J. Kaufman, Alexander Rihm, Jr., and James G. Terrill, Jr. The subject of shielding will be continued in next month's installment.

Introduction

This installment and the next will discuss, in an introductory manner, shielding against the several types of ionizing radiations that are capable of damaging man. The exact mechanism responsible for the damage is not fully understood because of the complexity of the living cell. The energy deposited in tissue is expended in ionizing and exciting the molecules composing the tissue through the action of the electric charge carried by the electrons, protons, and recoil nuclei liberated by the radiation. Under the influence of ionizing radiations, electrons are ripped from molecules leaving charged ions, or the composition of the molecules may be altered and damage to the living cell may take place.

Units and Definitions

Definitions of a few of the commonly used terms in nuclear physics necessary for an understanding of shielding are presented for later reference.

1. The curie is a measure of the activity of a radioactive source. It is currently defined as that quantity of a radioactive preparation which undergoes 3.7×10^{10} disintegrations per second.

2. The roentgen is that "quantity of X- or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, ions carrying 1 esu (electrostatic unit) of quantity of electricity of either sign (1)." The rep (roentgen equivalent physical) is a generalization of the roentgen to other types of radiation. A rep of any radiation is that corresponding to the absorption of 93 ergs/gm of soft tissue. The roentgen and rep are sensibly equal for photons with energy less than 3 million electron volts (Mev).

3. Flux gives a measure of the number of photons or corpuscles in a given radiation field and is essentially the number of particles crossing the surface of a sphere

(*Continued on page 98*)

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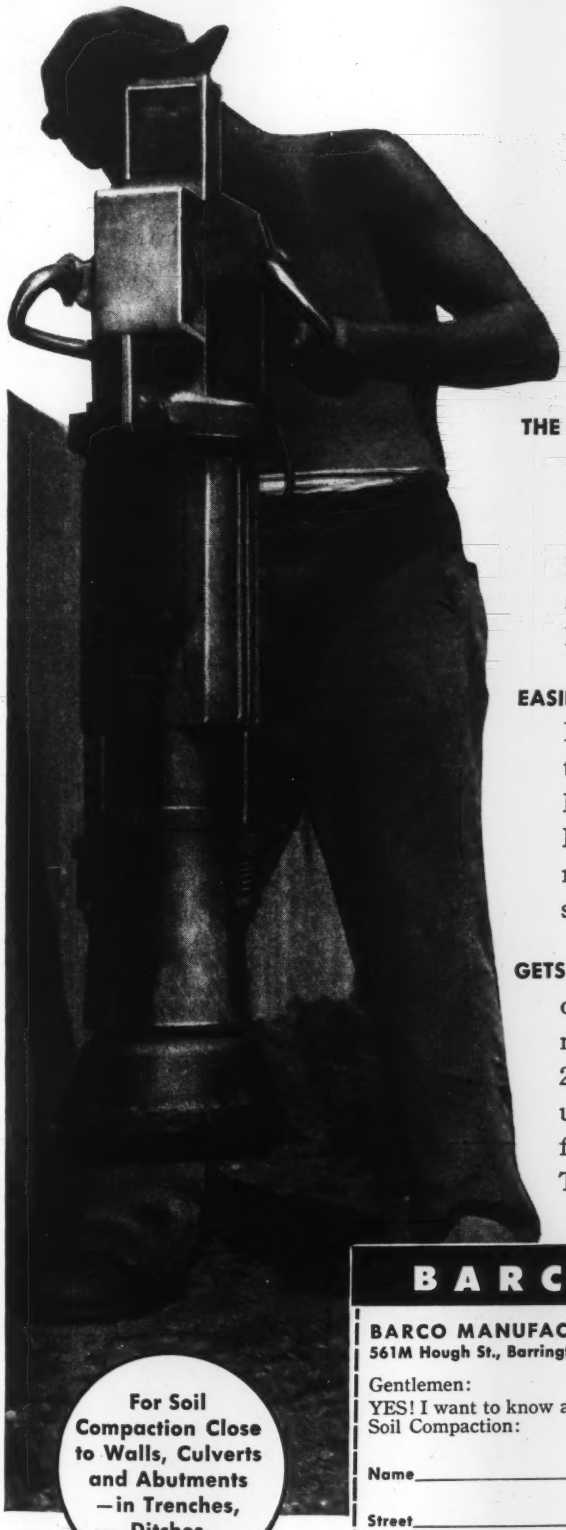

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The Readers Write. . .

(This department begins on page 62)

(*Continued from page 64*)

mating the effect on stress loss of a permanent dead load applied to the beam at some time after prestressing. An example would be the cast-in-place portion of a composite beam.

DONALD A. SAWYER, J.M. ASCE
Instructor of Civil Eng., Univ. of Florida

Gainesville, Fla.

Competitive bidding not inevitable

TO THE EDITOR: The article, "Competitive Bidding—Impact of Modern Business on Practice of Engineering," by Raymond A. Hill (August 1955 issue), is an interesting analysis of the factors producing increased economic competition for engineering work. Whether they recognize the fact or not, all engineers engaged in private work, employer and employee alike, are affected by this subject. It concerns not only the status of engineering as a profession but also the compensation earned through rendering engineering services, thus affecting engineering fees and salaries.

Obviously, competitive bidding on a price basis works to the financial disadvantage of the engineering profession as a whole. If a certain quantity of engineering work is available in a certain area to engineering firms *A*, *B*, *C*, and *D* there will be a total loss to these firms considered as a group if they can be persuaded to cut each other's throats in price competition for the work. If firms *A*, *B*, *C*, and *D* cooperate in upholding professional standards, refusing to stoop to economic competition or fee cutting, they must inevitably benefit financially in the long run. The enlightened self-interest of engineers lies in cooperation, not in competition.

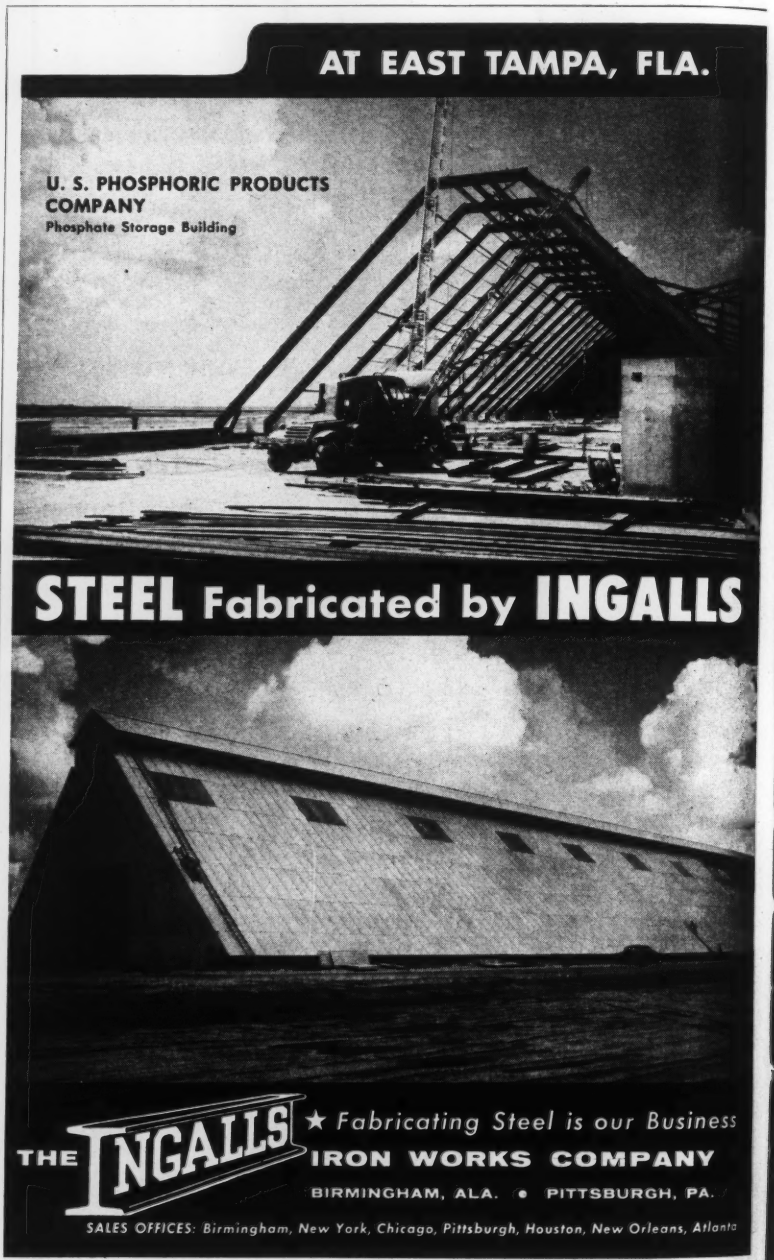
This raises the question concerning the right of the engineering profession to regulate the conditions through which the services of its members shall be procured. Mr. Hill states, "The buyer of engineering services may recognize that the value of the service of one firm is greater than the value of the service of another but he has the right to demand that the sale price of such services reflect these differences." And so he does, but he does *not* have the right to require engineers to transgress their professional codes by engaging in open economic competition or secret fee-cutting. Since engineers have accepted the responsibilities of professional status, they are entitled to the rights and privileges of professional status. In my opinion, those engineers who forfeit their professional rights for fear of alienating clients have tacitly accepted the status of tradesmen. Unfortunately the maintenance of any ethical code occasionally involves material sacrifice.

Mr. Hill's article concludes with this question, "How can the prohibition against competitive bidding on a price basis be administered so as to best serve the public interest?" In my opinion, the general outlines of an effective program to be pursued by the engineering societies would include the following: (1) Open forum discussions on competitive bidding to stimulate interest among engineers and critical thinking about the problem; (2) increased efforts to obtain cooperation between engineering firms in resisting any demands that they compete on a price basis; (3) a public relations program designed to educate clients ignorant of the facts of professional life; (4) consideration of possible measures to be taken against engineers' clients who refuse to recognize the professional rights of engineers.

The present conditions leading to increased competitive bidding for engineering services are, by nature, neither inevitable nor unalterable. They will become so only if engineers lack the will to resist the efforts of materialistic clients who would degrade engineering to the level of a trade.

C. W. GRIFFIN, JR., J.M. ASCE
Stewart C. Barnett, Consulting Engineer

Camden, N.J.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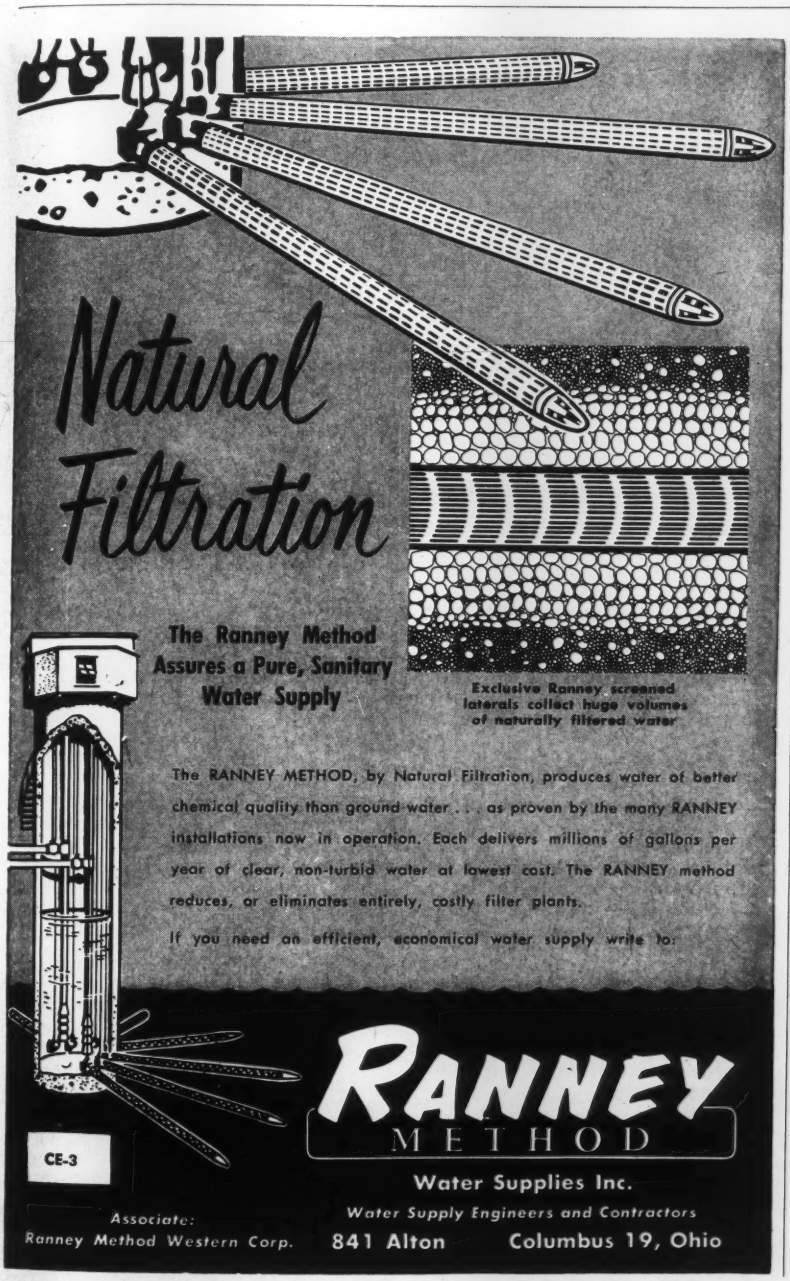
"History of Bridge Engineering" offered free to members

To the Editor: Many ASCE members would, I believe, like to receive a comprehensive, historical treatise on bridges, without charge. I will be glad to give a copy to each member—as long as my stock lasts.

These books are unbound copies of one of my late father's works, *History of Bridge Engineering*, which is long since out of print. Although I do not want to assume the expense and work of binding and selling these books, I would like to place each volume in the hands of some one who will appreciate its contents. That appreciation, I feel, can best come from those who have followed my dad, Henry G. Tyrrell, in the civil engineering profession (he graduated from the University of Toronto's, School of Practical Science, Class of 1886. As can be seen by consulting "Who's Who in America," any volume from 1910 through 1948, he was a recognized authority in his field.

I will be glad to send one copy of the above history to any civil engineer who wants one and will send postage and mailing envelope. Book postage within the continental United States amounts to 16 cents (of course it is much higher to points beyond). The mailing envelope costs 3 or 4 cents—so 20 cents should cover the mailing cost. Ten 2-cent stamps or seven 3-cent stamps would be about right.

Henry G.K. Tyrrell
BSME, Michigan State, 1950
Baltimore, Md.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Views on competitive bidding seconded

To the Editor: The article on "Competitive Bidding" by Raymond A. Hill, in the August issue, is extremely thought provoking. He has hit the nail on the head, I believe, as regards a trend that may affect our whole professional outlook. There have been tremendous economic and social tides at work for the past fifteen years that we seem to have no hope of controlling.

His argument, I believe, serves also to explain the apparent trend in thinking on professional ethics among so many in our national societies. A percentage large enough to be of real significance has been shown by recent surveys to see nothing wrong in collective bargaining for professionals. In other words, they feel there is no inconsistency between the two things, and one is not sacrificing his professional ideals (modern perhaps) by joining a collective bargaining unit for professionals. As Mr. Hill has pointed out, the Code of Ethics under which we operate was drawn up at a time when social and economic philosophy in many areas was considerably different from what it is today. Now the traditional philosophy about competitive bidding for professional services is being challenged. Perhaps these tides can be reversed, but we certainly cannot ignore them or shrug them aside.

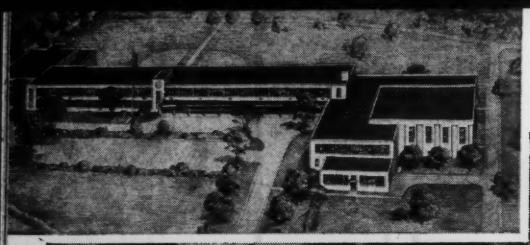
T. H. Evans
Dean, School of Engineering
Colorado A. & M. College

Fort Collins, Colo.

Uses toll roads from necessity not choice

To the Editor: Reference is made to the article on toll roads, in the September issue, and the statement on page 39 which reads, "Enthusiastic acceptance of toll roads by motoring public is one of most amazing developments of recent years." I disagree with the word "enthusiastic." I, and other users I know personally, use the New Jersey and Pennsylvania Turnpikes for only one reason, and this is that the state highways are so antiquated and so far behind the needs of present-day motor traffic in design that one must use the turnpikes in order to complete a trip safely and in a reasonable time. If the taxes that are levied on the automobile were allocated as they should be, there would be sufficient safe state and federal highways without the necessity of adding to the cost of travel to the automobile owner.

W. I. Stemwell, M. ASCE
Springfield, Va.



Richland Junior-Senior High School, Richland Township, Allegheny County, Pa.
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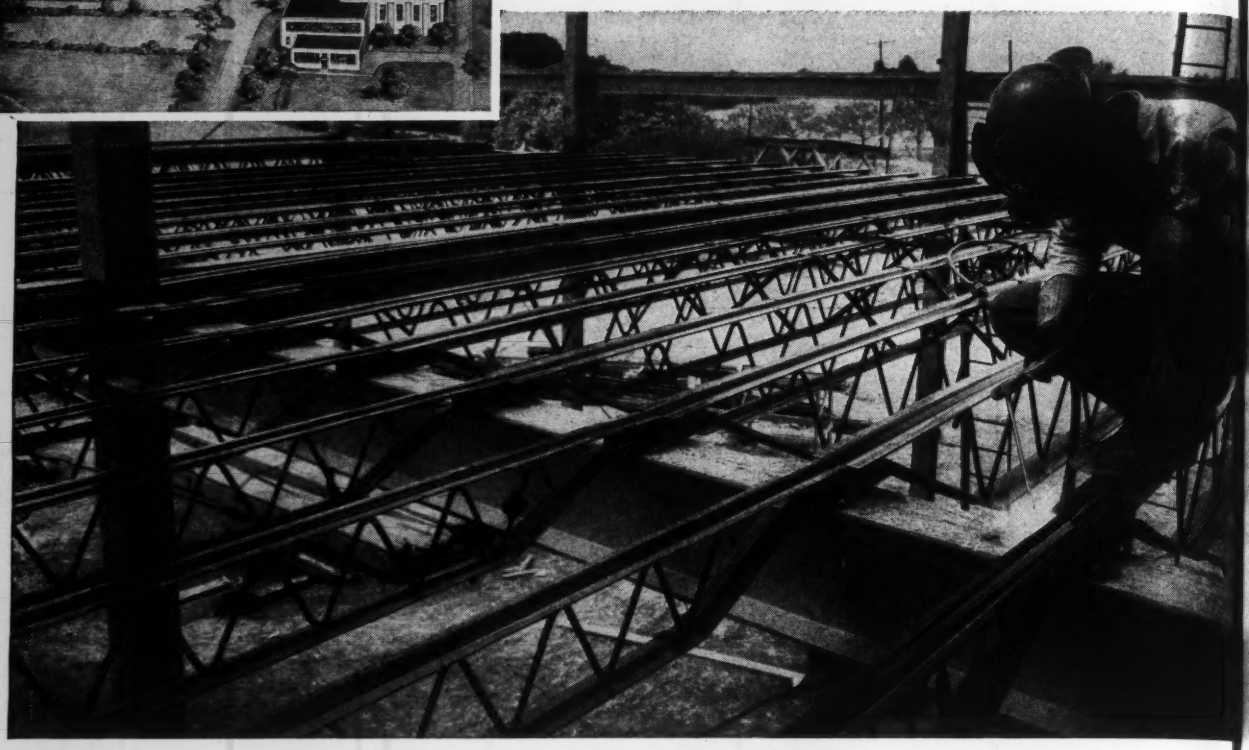

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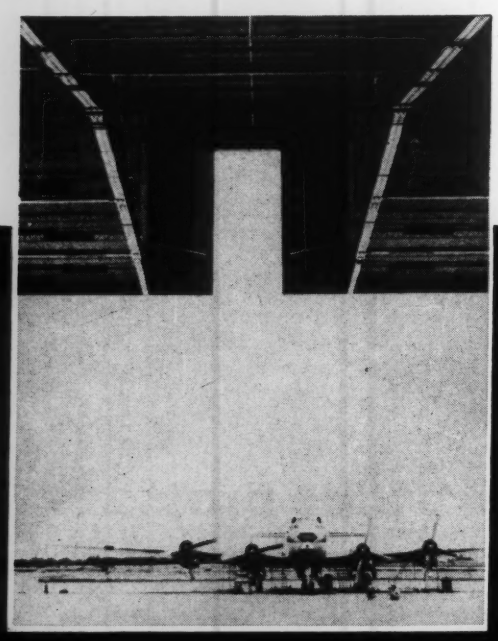
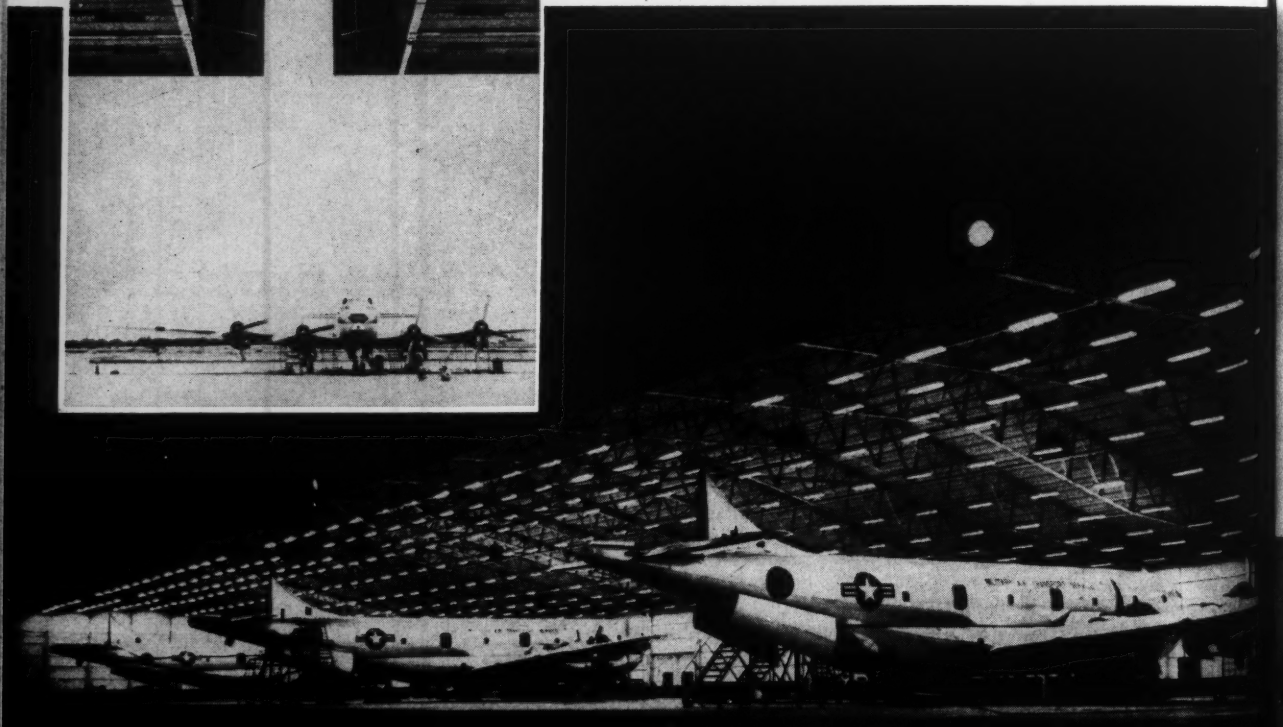
The 76-foot-long member which connects the top ridge of the cantilever to the top of the inner column is designed to act either in tension or compression—supports weight of roof loading, and withstands 30 psf uplift from wind under roof.

Ingenious hangar



Vertical clearance rises to 45 feet inside the three tail housings which open at the edge of the overhanging roof to admit the tails of these Boeing Stratocruisers.



The unique hangar was designed and constructed by the Erwin-Newman Co., of Houston, Texas, under their design patent No. 2,687,102.

The hangar is designed for 25 psf roof load and 15 psf horizontal wind force. Rear columns are bolted to deep concrete piers since they must withstand a pull of 14 tons per column from the weight of the cantilevered roof structure, which amounts to only 11.8 psf.

has no columns...

cantilever construction spans 120 ft. at cost of only $2.40 per sq. ft.

• The hangar area of this efficiently-designed building of Temco Aircraft Corporation at Greenville, Texas, is completely unobstructed by supporting columns. The clear area measures 120 ft. deep x 432 ft. long x 30 ft. high.

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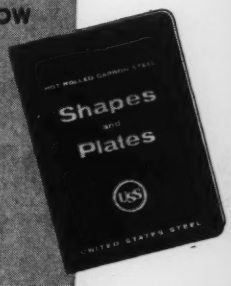

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Nuclear Notes

(*Continued from page 86*)

of unit cross sectional area per unit time at the point in question.

Types of Ionizing Radiation

Broadly speaking, ionizing radiation may be divided into two classes: (1) electromagnetic radiation, such as, X and γ radiation (photons) and (2) corpuscular radiation. The second class includes neutrons, alpha particles (helium nuclei), beta particles (energetic electrons), protons (hydrogen nuclei), neutrinos, mesons, and others. The most important radiations from the standpoint of shielding are X and γ radiation and neutrons. It is to be noted that these produce ions in matter only indirectly, neutrons (upon so called "elastic" collisions with matter) give rise to recoil nuclei or when captured by nuclei to gamma or charged particle emission. X and γ rays produce electrons and/or positrons (positively charged electrons) when they interact with matter. Because neutrons and photons do not ionize directly they may have rather long "ranges" in matter and thus constitute the most dangerous radiations from a shielding viewpoint. On the other hand, the charged particles such as electrons, alpha particles, protons, etc., interact strongly with matter and hence penetrate only a comparatively short distance before losing their energy.

Most radioisotopes emit both beta and gamma rays. The beta rays are easily shielded out—for example, only 1.5 mm of aluminum are needed to completely stop a 1 Mev beta particle which is rather energetic compared with most betas emitted by radioactive nuclei. The heavier naturally radioactive nuclei emit α particles with energies in the range of 4 to 8 Mev. Since the outer layer of the human skin stops most α particles in this range they are clearly not dangerous in external exposure. However, α emitters when breathed or ingested may be very injurious to man if they remain in the system for an appreciable time.

Although neutrons constitute a very important problem in shielding, most of the information is classified. Because of this and for reasons of brevity in the sequel we shall consider only shielding against X and γ radiation. In the references at the end of the second article material on neutron shielding may be found.

Sources of Radiation

The sources of radiation which are at present most important with reference to shielding are radioisotopes, X-ray machines, and nuclear reactors. High-intensity sources of gamma rays are becoming more and more common in radiotherapy, while X-ray machines and their attendant hazards have existed for many years. The nuclear reactor is a source of several different radiations and many aspects of the shielding of neutrons which have been investigated by the use of reactors are only now emerging from the realm of secret information.

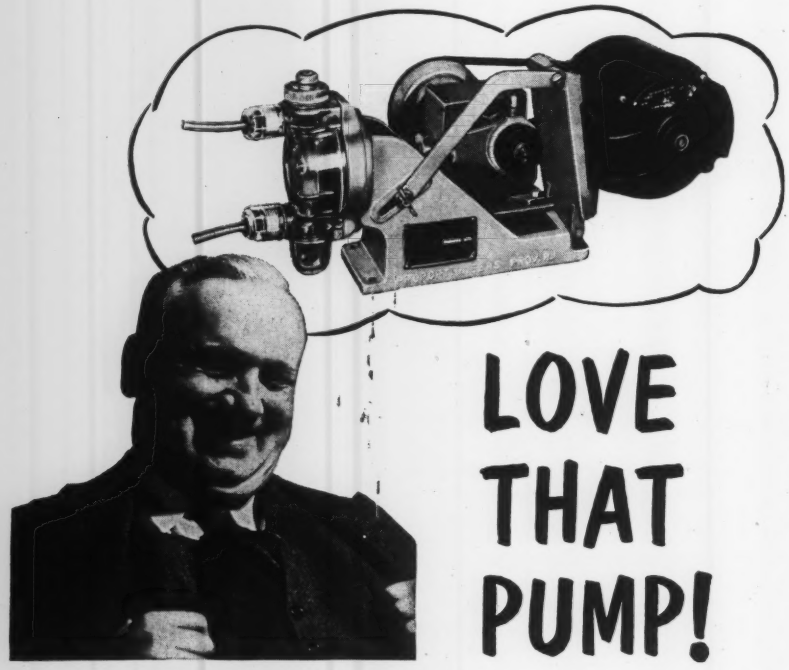
X-ray machines ordinarily generate X-rays in the energy range, 50,000 to 100,000 electron volts (kev), while gamma rays usually encountered lie in the range 0.01 to 5 Mev. Fast neutrons from a reactor are spread over quite an energy range, the majority having energies between 0.5 and 3 Mev. Sources of fast neutrons, such as polonium-beryllium, polonium-boron, or radium-beryllium mixtures, have average energies of from 1 to 3 Mev.

Fast neutrons passing through matter slow down by successive collisions with nuclei to give progressive lower energies until they eventually come to thermal equilibrium with the nuclei of the matter at about 0.03-ev energy and subsequently diffuse until captured. The nuclei of many elements capture thermal neutrons with high probability and subsequently emit a gamma ray or a charged particle. Since these emitted gamma rays may require shielding, thermal neutron absorbing materials should be chosen from the charged particle emitters, such as boron, which require no further shielding.

Interaction of Photons with Matter

There are three main processes by which photons in the energy range from a few tens of kilovolts to 10 Mev interact with matter.

(*Continued on page 100*)



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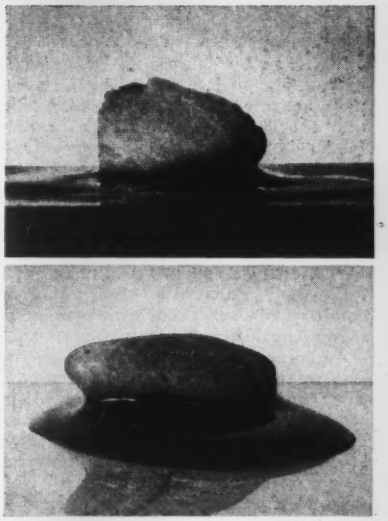

These laboratory photographs show the superior ability of Bitumuls to "wick-up" on the sides of cover chips. Top is a stone put down in an asphalt cut-back; lower, stone put down in Bitumuls.

AMERICAN Bitumuls & Asphalt COMPANY

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Nuclear Notes

(*Continued from page 98*)

In the first of these, the *photoelectric effect*, a photon is absorbed by an atom and an electron is ejected after absorbing all of the photon energy. This effect predominates for lower energy photons, and especially for high atomic number materials.

In the *Compton Process* a photon is scattered and an atomic electron recoils as though it had been nearly free initially. This effect predominates for gammas of 1 to 5 Mev in materials of high atomic number and over a much wider range of energies for lighter elements.

A photon of greater than 1-Mev energy may disappear creating an electron-positron pair (*Pair Production*) in the vicinity of an atom. This effect predominates for high photon energies, especially for high atomic number elements. The positron, after slowing down, combines with electrons to give two photons each of 0.511-Mev energy.

Heavier elements—for example, lead—are the best shields for photons since the photoelectric process is more probable. In this reaction the photon is completely absorbed so that it can produce no more damage. On the other hand, in the Compton scattering process, though a photon loses some of its energy, it may proceed to produce more ionization.

Materials for Gamma Shielding

As was indicated above, elements of high atomic number are best for the shielding of X and gamma radiation. Lead is commonly used for this purpose but for reasons of structural strength concrete and steel are often employed. To increase its effectiveness, concrete may be modified by using barytes or steel pellets as aggregates.

To prevent the scattering of radiation from the air and structures above shielding barricades containing strong sources, the top or ceiling side of these shields should never be omitted unless the source is smaller than 10 curies. Even if the source is less than 10 curies, it may be necessary to use auxiliary shielding over the source to minimize air and structure scattering for certain configurations. Thin sheets of lead may be used for this purpose. If strong beta particles are also emitted by the source one must take care that the bremsstrahlung (photons) generated by the deceleration of betas do not constitute another hazard. To minimize this generation the thin lead sheet should be faced with a material of low atomic number, such as plastic or wood, which is sufficiently thick to stop all beta particles. If the lead sheet is sufficiently thick, it will attenuate the bremsstrahlung generated therein so that there is no danger from this effect (see next month's installment).

N * G * Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"For once," chirped Joe Kerr, "I know I'm right."

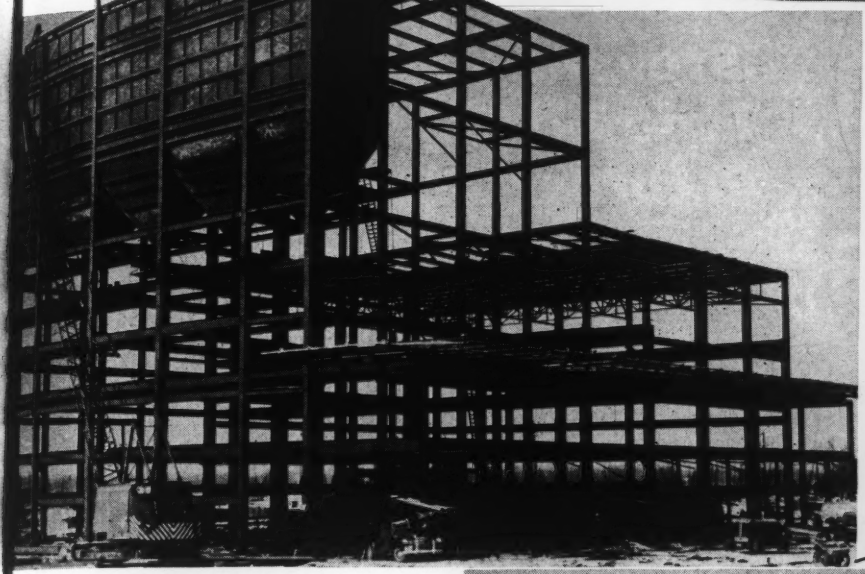
"A nice thing to know," agreed Professor Neare, "if. . ."

"There's no 'if.' You set a time limit for each play in the blox-in-box game and asked, 'How soon *can Joe* surely send Fay to bed?' Maybe I *could* do it sooner, or maybe Cal *can*, but I'm the only guy that knows how soon *Joe can*, or how smart a girl Fay Kerr is!

"You see, I tried Cal's symmetry rule first, like this:

(*Continued on page 102*)

Fine Craftsmanship
in STRUCTURAL STEEL



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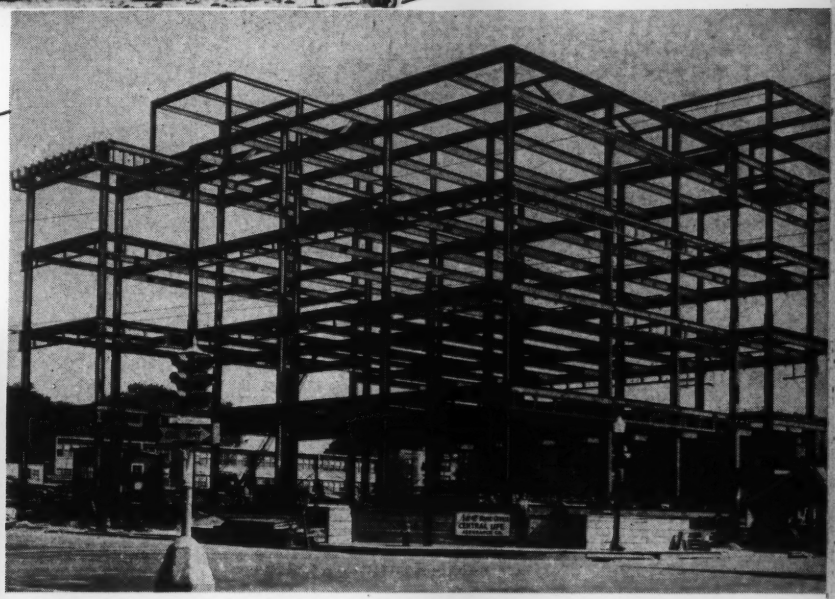
Richmond, Ind.

for a wide range of industrial and commercial requirements—

Coast to Coast...



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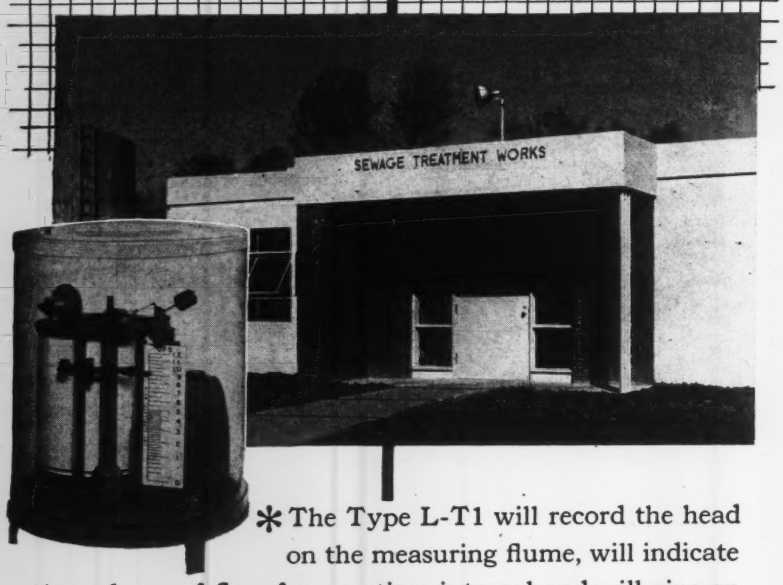
PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:
Stevens Type L-T1 Recorder*



*The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

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144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

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Foremost in Precision Hydraulic Instruments Since 1907

N. G. Neare's Column

(*Continued from page 100*)

Play	Blocks per pile
0	1 2 3 4 5 6 5 4 3 2 1
1	1 2 3 4 5 5 4 3 2 1
2	1 2 3 4 4 5 4 3 2 1
3	1 2 3 4 4 4 4 3 2 1
20	1 1 1 1 1 1 1 1 2 1
21	1 1 1 1 1 1 1 1 1
29	1

I made the odd plays, starting by taking the 6-pile. Fay delayed by taking only one block each time and leaving as many piles as possible. To keep symmetry, I could take only one block at a time until the 21st play, when I had to take 2 to leave an odd number of 1-piles for the end play. I played instantaneously, but Fay always took her allowance of 5 sec plus 1 sec per pile. She had 10 plays at 15 sec, then 14, 12, 10, 8 and 6 for a total of 200, going to bed at 8:18:20."

"So that's the best you *can* do?"

"That's *my* best. Once at Play 3 I took the whole 5-pile, but *I* went to bed at 8:16:06. That was *Fay's* best!"

"Poor Joe," gloated Cal Klater. "It's time he learned some binary arithmetic, in which the denary numbers 1, 2, 3...are written 1, 10, 11, 100, 101, 110.... Suppose you use these numbers to list the number of blocks per pile in form for addition and then add column by column of digits. With symmetry, each column will have an even total, and no matter how your opponent plays, he will leave at least one odd column, and on your next play you can make them all even again. You must play on some pile represented by a digit in the leftmost odd column, which may give you an unsymmetrical choice, e.g.:

2	1 2 3 4 4 5 4 3 2 1
3	2 3 4 4 5 4 3 2 1
4	2 3 4 4 4 4 3 2 1
5	2 3 4 4 4 4 3 2
21	1 1 1 2 2 1 1 1
22	1 1 1 1 2 1 1 1
23	1 1 1 1 1 1 1
29	1

Hence Fay is quickly cut down to 13 sec per play, with a total of 182, putting her to bed at 8:18:02."

"Good," applauded the Professor, "and if you don't see the whole story, play around with the binary additions yourself. Otherwise, imagine the elation of Hyde Rollix when 169 attended his lecture on *Prestressed Rock-fill Dams* after only 49 had shown up for Matthew Merist's paper on *Inversion of Ecneics*. Then imagine his deflation upon learning that this was the exact expectancy if all speakers were equally popular and each registrant for the technical division meeting attended a series beginning and ending with his two favorites. How many spoke?"

[Cal Klaters, and both binarians, were H. Francis Finch and Ed C. Holt, Jr.]

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DECEASED

Charles Russell Bates (A.M. '51), age 39, a partner in the firm of Charles A. Bates & Sons, at Bloomington, Ill., died recently. A 1939 graduate of the University of Arizona, Mr. Bates was briefly associated with the Illinois State Highway Department and the U.S. Department of Agriculture in Arizona. He was in the Charles A. Bates & Sons' firm from 1940 until his death, with the exception of four years of war time service as a captain in the U.S. Army.

Victor Jarvis Bedell (M. '31), age 71, partner for the past ten years in the New Orleans firm of Bedell & Nelson, consulting engineers, died August 28. Mr. Bedell, who graduated from Tulane University in 1905, served with the Army Corps of Engineers in both World Wars. From 1937 to 1941 he held the position of general manager of the New Orleans Public Belt Railroad.

Winston Edward Black (A.M. '48), age 35, member of the University of Illinois engineering faculty, Urbana, died on August 1. Professor Black started his career by teaching at his alma mater, the University of Illinois, from which he graduated in 1936. He was in the Corps of Engineers from 1942 to 1945, stationed at Fort Belvoir, Va., and Yuma, Ariz. He then returned to his post at the University of Illinois.

George Alton Blyth (J.M. '49), age 31, of Great Falls, Mont., died there on September 12 of polio. Mr. Blyth, a graduate of Montana State College, had been associated with the Bureau of Reclamation, Lower Marias Unit, and more recently was employed by the Anderson Construction Co., as a civil engineer at Great Falls. Active for some time in the Montana Section and its North-Central Branch, Mr. Blyth was serving as president of the Branch at the time of his death. He had also been vice-president of the Section.

Conrad Oscar Bostrom (M. '50), age 30, of Harhan, La., died September 12. A 1945 graduate of Tulane University, Mr. Bostrom served in the Civil Engineer Corps of the U.S.N.R., in 1945 and 1946, and then was an instructor at Louisiana State University. Mr. Bostrom was a construction superintendent for Bartley & Binnings, General Contractors, New Orleans, at the time of his death.

George Washington Buck (M. '31), of Portland, Ore., died August 20 at the age of 78. Mr. Buck had been Multnomah county engineer and roadmaster for the past 30 years. Earlier in his career Mr. Buck engaged in railroad location and construction for several Western lines. He was a graduate of the University of Minnesota, class of 1899.

Albert Walter Carlson (A.M. '42), age 45, of Chicago, was killed in an automobile accident on July 21 while on duty with the Corps of Engineers. A 1935 graduate of the University of Illinois, Mr. Carlson became associated with the International Boundary Commission, United States and Mexico, in 1939. A few years later he joined the Corps of Engineers with which he served until his death.

John Francis Cassidy (M. '48), age 53, acting division engineer for the New York Board of Water Supply for Katonah, N.Y., died there on August 25. A 1925 graduate of Manhattan College, Mr. Cassidy was associated with the New York Board of Transportation from 1926 to 1933 engaged on the construction of the Eighth Avenue subway. From 1934 through 1937 he was resident engineer inspector for the PWA on construction of the Triborough Bridge. From the latter year until his death Mr. Cassidy was with the New York Board of Water Supply.

Malcolm Elliott (M. '16), age 74, consulting engineer of St. Louis, Mo., and retired colonel in the Corps of Engineers, died on August 24. Early in his career he was employed in a civilian capacity on the construction of the Panama Canal. In the Corps of Engineers from 1910 until his retirement nine years ago, Colonel Elliott had served as district engineer at Wheeling, W. Va., in charge of construction and operation of Ohio River locks and dams; superintendent of construction of Wilson Dam; district engineer at New Orleans; president of the Alaska Road Commission in charge of the construction and maintenance of all roads in Alaska; and division engineer for the Upper Mississippi Valley Division, with headquarters at St. Louis.

Colonel Elliott

Donald Lewis Glover (J.M. '49), age 30, of Belleville, Ill., was killed in an aerial collision in Alabama on August 20. Mr. Glover, a first lieutenant in the Air Force Reserve, was serving his two weeks of active training at Scott Air Force Base at Belleville. At the time of his death he was employed as a structural engineer for the Fruin-Colnon Contracting Co., St. Louis. He was a 1949 graduate of the University of Illinois.

Ernest Payson Goodrich (M. '05), age 81, noted consulting engineer, city planner, and former director of ASCE, died in Brooklyn on October 7. An 1898 graduate of the University of Michigan, Mr. Goodrich worked as an engineer in the Navy until 1903; for the Bush Terminal Co. until 1910; and the Manhattan Public Works Department until 1916. He set up private practice and later worked for the Albany Port Commission, the New York City Sanitation Department and, after World War I, the War Claims Board. During World War II, he was associated with the Price Adjustment Board doing Navy work. The Brooklyn Polytechnic Institute of Brooklyn, of which Mr. Goodrich had been an official for thirty-six years, awarded the honorary degree of Doctor of Engineering to him posthumously on October 8. Mr. Goodrich was ASCE Director from 1940 to 1942. He was also past-president of the American Institute of Consulting Engineers.

E. P. Goodrich

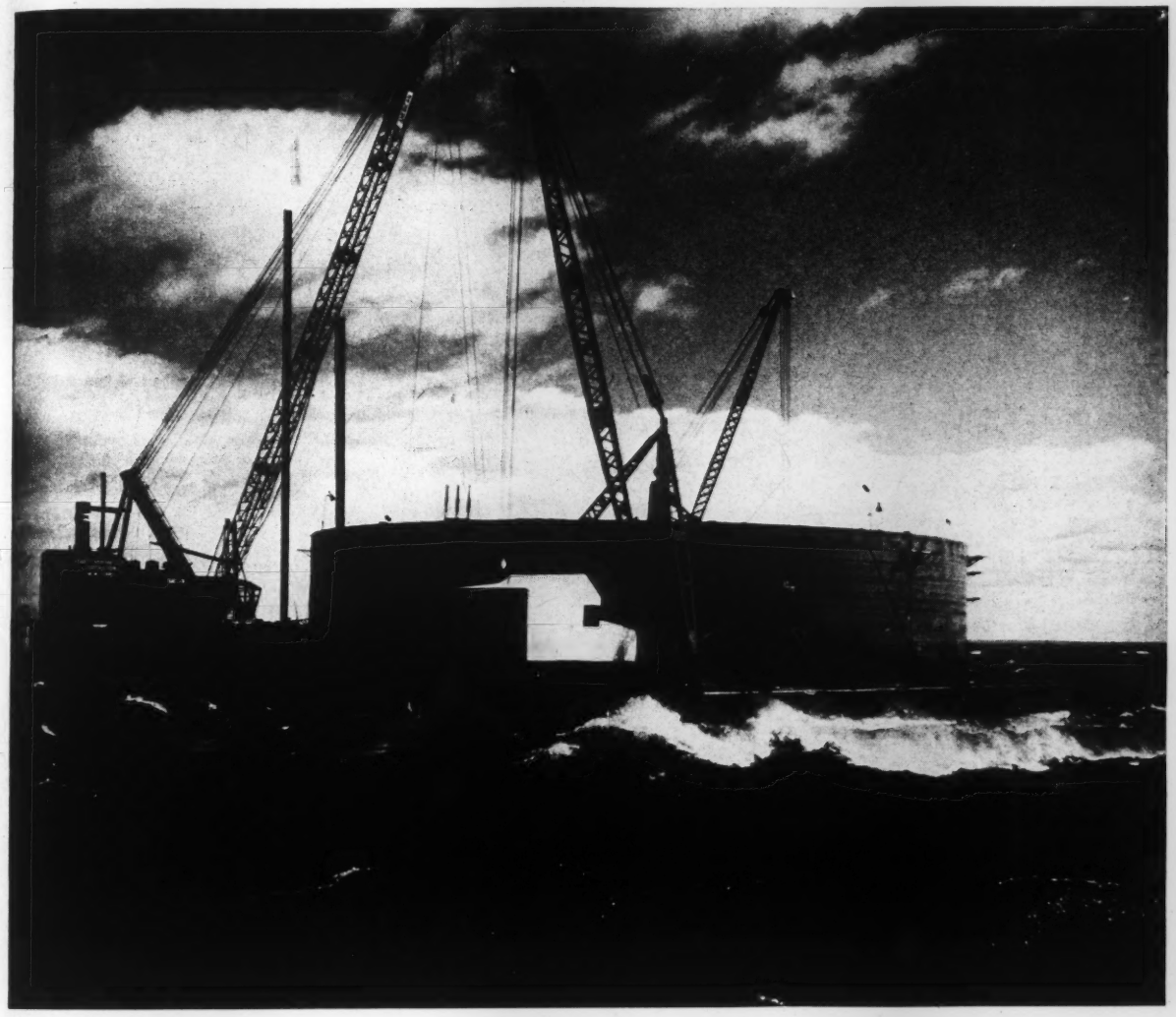
James H. Griffin (M. '33), age 66, who retired last June as chief engineer of the New York City Transit Authority, died at his home in Darien, Conn., on September 18. Mr. Griffin served on the Authority's engineering staff from 1913 until his retirement except for two years overseas in World War I as a captain in the Corps of Engineers. When he became chief engineer in 1945 he was the youngest man to have held the post. Projects undertaken during his tenure included construction of Brooklyn extensions of the I.R.T. and B.M.T. and construction of the entire Independent system. Mr. Griffin was a graduate of Union College, class of 1912.

Norman Bateman Hodgkinson (M. '52), age 57, division engineer with the Los Angeles County Flood Control District and a resident of South Pasadena, Calif., died recently. Joining the Flood Control District in 1927, Mr. Hodgkinson held the positions of assistant chief and chief designing engineer, and division engineer with the Flood Protection Branch. Since 1945 he had been division engineer in charge of the Investigation Division. Mr. Hodgkinson was educated at the University of California.

Augustus Hunt (A.M. '20), age 68, retired civil and sanitary engineer, of Oklahoma City, Okla., died at his home there on September 11. In his early career Mr. Hunt was assistant city engineer of Minot, N.D., and city engineer for Crookston, Minn. More recently he had been in the oil lease, royalty, and investments business in Oklahoma. Mr. Hunt was a graduate of Rutgers University, class of 1911.

Loy Ray Hunter (A.M. '42), age 45, of Bartlesville, Okla., died on March 29. In 1933 and 1934 Mr. Hunter was employed by Harrington & Cortelyou, Kansas City, Mo., as an engineer on the design and detailing of bridges. He then became an engineer with the Phillips

(*Continued on page 106*)



CB&I helps beat "Old Man Winter's" Deadline

"Old Man Winter's" icy breath set the deadline for the CB&I erection crew that assembled fabricated steel sections for piers 19 and 20 of the $80-million Mackinac Straits bridge in northern Michigan.

From start to finish, the job was a dramatic 24-hour-a-day race to defeat the tremendous forces of winter, wind and water. If the caissons were not in place before winter set in, considerable damage could have resulted to them from the ice that sometimes reaches a thickness of 40-feet in the straits.

Work on the two 116-foot diameter caissons, subcontracted from Merritt-Chapman & Scott Corporation, was started on September 13th, 1954 and completed on November 30th, weeks ahead of the deadline set up by Nature itself. Such is the ability of the Chicago Bridge & Iron Company.

From engineering, fabricating and erecting welded steel storage tanks and other steel plate structures to a race with "Old Man Winter," Chicago Bridge & Iron Company has complete facilities, experience and knowledge to do the job right.

Write our nearest office for estimates or quotations on any welded steel plate structure or storage vessel that you might need. There is no obligation.

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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA

Deceased

(*Continued from page 104*)

Petroleum Co., Bartlesville, and remained in their employ until his death. Mr. Hunter was a graduate of the University of Kansas, class of 1933.

Arvon Stanley Jones (M. '43), age 58, assistant city engineer of Des Moines, Iowa, died there on July 24. Mr. Jones was with the City of Des Moines from 1919 until his death, except for a few years as draftsman for the Des Moines Steel Co. As designing engineer for the city for a number of years, he was in charge of the design of facilities for the Des Moines sewage-treatment plant.

Oliver Linton King (A.M. '28), age 56, township engineer of Abington, Pa., died on June 10. A 1922 graduate of Bucknell University, Mr. King had been senior inspector for the Pennsylvania Department of Highways and assistant engineer with the Philadelphia civil engineering firm of Albright & Mebus. Mr. King became associated with the Township of Abington, Pa., in 1927, serving first as building inspector and later township engineer.

George Walther Koss (M. '22), age 76, founder of the Koss Construction Co., of Des Moines, Iowa, died there on August 8. He graduated from Rensselaer Polytechnic Institute in 1901. One of the first big Mid-Western contractors, Mr. Koss founded his own company in 1908. He was the president and general manager until 1946, when he became chairman of the board. He was a charter member and director of the Associated General Contractors.

Henry Monroe Lathrop (A.M. '23), age 62, of Mountain Home, Ark., died on September 8 in Little Rock. A graduate of Yale University, he started his career as an assistant engineer with the Central Jersey Railroad. During World War II, Mr. Lathrop was a commander in the Civil Engineer Corps of the Navy, serving at the Bureau of Yards and Docks in Washington, D.C. and Chicago. Later he was president of the Baxter County Building Association and the North Arkansas Building and Supply Co., Inc., and also engaged in consulting engineering work.

Frederick Atwood Pease (A.M. '07), age 81, retired engineer of Cleveland, Ohio, died in Clearwater, Fla., on July 3. Mr. Pease founded the F. A. Pease Engineering Co. in 1903, the same year he laid out Fairmount Boulevard, (believed to be the country's first divided highway). For more than 50 years he was a key figure in the development of Greater Cleveland. He was also a founder of the Cleveland Society of Professional Engineers.

Loren Pease Plummer (A.M. '23), age 72, of Radnor, Pa., died on September 10. A graduate of Rutgers University in 1905, Mr. Plummer had been city engineer of Los Angeles and, at various times, was associated with the Corps of Engineers. Beginning in 1922, he was, for a number of years, topographic engineer in the New Jersey Department of Conservation and Development at Trenton.

Leon Benedict Reynolds (M. '21), age 70, emeritus professor of hydraulic and sanitary engineering at Stanford University, died on September 26. Long interested in engineering education, Professor Reynolds served at Stanford from 1923 to 1950. He graduated from Hillsdale College with an A.B. in 1906. Except for graduate work at Cornell (1911–12), he was with Burns and McDonnell, consulting engineers of Kansas City, Mo., from 1909 to 1923. Professor Reynolds served as president of the San Francisco Section in 1931 after two years as vice-president. He was also active in many professional associations, including the California Sewage Works Association which he helped found and which he served as first president of in 1928.

Professor Reynolds

Francis Joseph Sette (M. '35), age 57, died on July 20 in Gainesville, Fla. A 1920 graduate of Yale University, Mr.

(*Continued on page 108*)

FIRST FOURTEEN YEARS OF LAKE MEAD
Horizontal Control, by R. M. Wilson
The triangulation during 1947-48 had several purposes; first, to recover triangulation stations set by Fairchild Aerial Surveys for control of the 1935 topographic maps made for the Soil Conservation Service (U. S. Department of Agriculture, 1935) and to test the precision of their coordinates; second, to tie in points of other previous surveys wherever possible, so that all these surveys might be coordinated on a common datum; and third, to establish convenient reference points for the 1948-49 hydrographic survey and to mark them permanently so that future surveys can be referred to the same points.
Altogether, 336 new reference points and triangulation stations were established, most of them just above the high-water mark of the reservoir. About 35 navigation lights or other objects were located by intersection, 15 stations of the Coast and Geodetic Survey were recovered and occupied, and 33 stations established in previous surveys were tied in. The position closures involved in all these ties indicate excellent work in the earlier triangulation in this area. Analysis discloses that the triangulation of 1935 is dependable and accurate, and entirely adequate for the purposes of this investigation, some of which required a higher order of accuracy than that required for use in making the maps under the 1935 contract.
GEOLOGICAL SURVEY CIRCULAR 346, 1954

14 years later

That's the way it always is with a topographic map. The map is needed yesterday. Costs are building up by the hour. No time to check or have it done over again.

It must be right to begin with: The flying, the control, the cartography. As in this case clients have learned . . . *you can depend on Fairchild.*

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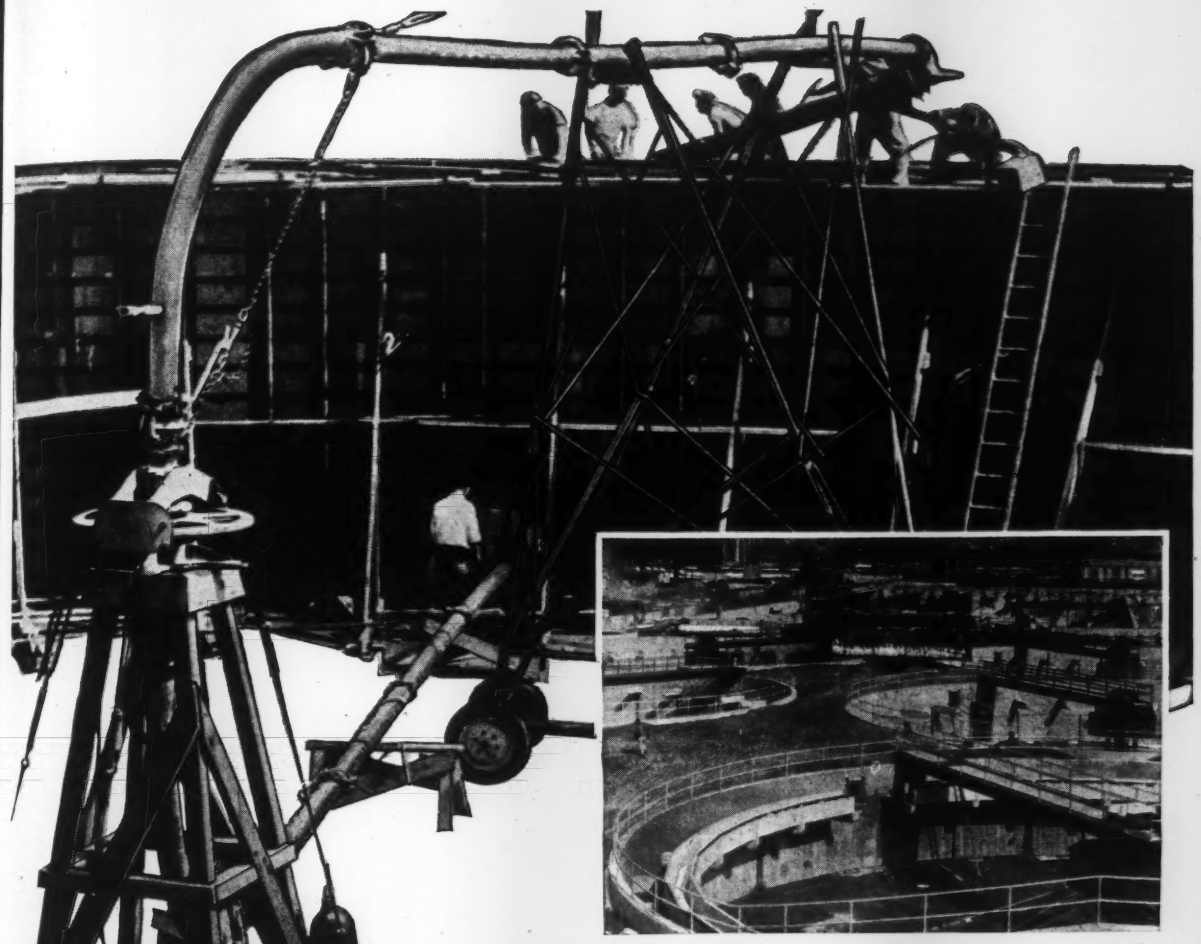

Unique method of placing concrete saves time and money at Grand Rapids sewage plant

Using a special swivel pump rig to place concrete in six 100-ft. diameter settling tanks at the Grand Rapids, Mich. sewage treatment plant saved considerable time, labor and money.

As the photo shows, concrete was pumped through a rotating conduit and deposited continuously in the forms. Each tank required 180 cu. yd. of concrete and was completed in a seven-hour day by a seven-man crew.

This demonstrates concrete's adaptability to the special conditions of any job. Placed by this or another method, concrete is the ideal material for sewage treatment plants and facilities.

Concrete is moderate in first cost. It requires little or no maintenance. It has extremely long life. The result is ***low-annual-cost*** service.

For more information on concrete construction for sewage treatment plants write for a free illustrated booklet, "*Sewage Treatment Works.*" Distribution limited to the U. S. and Canada.

PORTLAND CEMENT ASSOCIATION Dept. A11-13, 33 West Grand Avenue, Chicago 10, Illinois
A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

Deceased

(*Continued from page 106*)

Sette did graduate work at M.I.T. and Harvard where he received his M.S. Until his retirement for reasons of health, he was deputy director of the Resources Division, Research and Development, Department of Defense, Washington, D.C. Mr. Sette was chairman of the Committee of Technology of the U.S. Department of Agriculture Graduate School, Washington, D.C., for a number of years. He had also taught at Norwich University, the University of Puerto Rico, and Virginia Polytechnic Institute.

Joseph Edward Settle (M. '32), age 67, of South Hills, W. Va., died recently in Charleston. A 1907 graduate of West Virginia University, Mr. Settle went to Charleston in 1927 as a consulting engineer. At the time of his death he was president of the Settle Engineering Co. of Charleston, which is currently designing and building the city's new multi-million-dollar sewage-disposal plants in the southern part of the state. Mr. Settle was instrumental in drafting the State's engineering registration laws.

Ralph Vernon Weston (J.M. '52), age 24, Second Lieutenant, U.S. Air Force, was killed in a jet airplane crash in England on August 22. Mr. Weston entered the service in 1952, following his graduation from the University of North Dakota. He received his jet pilot wings at James Connally Air Force Base, Waco, Tex., and had been stationed at Luke Field, Ariz., and Greenville, Miss., before his assignment overseas.

[Editor's Note: John Rowe Newell (A.M. '21), age 70, who was associated with the Helms Concrete Pipe Co., of Alexandria, Va., died in Washington, D.C., on March 13. A graduate of the University of Minnesota, Mr. Newell was for many years part owner and general manager for the Mid-West Concrete Pipe Co., with headquarters in Chicago. In the August issue (page 102) it was erroneously stated that Mr. Newell was president of the Mid-West Concrete Pipe Co., at the time of his death.]

New Publications

Engineers in industry . . . Findings of a nationwide survey recently completed by the Professional Engineers Conference Board for Industry in cooperation with the National Society of Professional Engineers make up a comprehensive report entitled "How to Train Engineers in Industry." More than 200 companies employing a total of 1,531,254 persons (many of them engineers) contributed to the research survey project. The report—fourth in a series of executive survey projects—is designed to furnish practical and helpful information to industry concerning engineer-management problems. Copies sell for $2, and requests should be sent to the NSPE, 1121 15th St., N.W. Washington 5, D.C.

Beach erosion . . . Availability of several studies dealing with beach erosion and protection of shore, harbor and other maritime structures is announced by the Beach Erosion Board. The new publications are entitled "Laboratory Study of Effect of Tidal Action on Wave-Formed Beach Profiles," Technical Memorandum No. 52; "Restudy of Test-Shore Nourishment by Offshore Deposition of Sand, Long Branch, N.J.," Technical Memorandum No. 62; "Wave Forces on Piles: a Diffraction Theory," Technical Memorandum No. 69; and "The Effect of Fetch Width on Wave Generation," Technical Memorandum No. 70. Inquiries should be addressed to the Beach Erosion Board, Office of the Chief of Engineers, Corps of Engineers, Washington, D.C.

Water pollution, Sacramento River Valley . . . Important data on water pollution in the Sacramento River watershed have been summarized by the Central Valley Regional Water Pollution Control Board in a recent (1955) study. Specifically the 68-page illustrated work sets forth the whole story of the Sacramento Valley water problem as it relates to the use and reuse of water, and the effect of such use and reuse on the quality of supply. Inquiries concerning the report should be addressed to the State of California Regional Water pollution Control Board, 608 13th St., Sacramento 14, Calif.

Water and Sewers . . . The 1954 Annual Report of Chicago's Department of Water and Sewers aims to present in pictorial form, with a minimum of text, the activities and operation of the Department for the year. Inquiries should be addressed to the Department of Water and Sewers Commissioner's Office, Chicago 2, Ill.

Fire-resistant structures . . . Results obtained in a program of 18 fire tests on open-web steel-joist floors are detailed in National Bureau of Standards Building Materials and Structures Report 141. James V. Ryan and Edward W. Bender are the authors. Orders will be filled by the Government Printing Office, Washington, D.C.

The hydraulic jump . . . More than 500 references to the hydraulic jump (domestic and foreign) are given in a 50-page bibliography compiled by Edward A. Elevatorski, hydraulic engineer for the U.S. Bureau of Reclamation. The period covered is 1819-1953. Copies are obtainable from Mr. Elevatorski, 513 Dartmouth, S.E., Albuquerque, N. Mex.

Nuclear power reactors . . . A 30-page report to the Atomic Energy Commission by the Nuclear Power Project Staff of the Foster Wheeler Corp., New York, and the Pioneer Service and Engineering Co., Chicago, is now available from the Government Printing Office at 15 cents a copy. The present publication (Vol. 2) reports on the practicability of building a nuclear reactor for the generation of control-station power, and summarizes design features of some of the reactors studied and makes economic analyses of them. Though none of the systems studied can produce central-station power at a price competitive with that produced from carbon fuels, two types show promise—the thermal U-233 homogenous breeder and the fast plutonium breeder—the report states. The first study reports made by private companies were published as Vol. 1 in 1953.

Prefabrication techniques . . . English reprints of a paper on "New Systems of Prefabrication of Industrial Hall Structures"—originally published in the *Acta Technica Academiae Scientiarum Hungaricae*, Tomus VIII, Fasc. 1-2, Budapest, 1954—are available. Requests should be sent to the author, Alexandre Major, C.E., c/o Technical Section No. VI of the Hungarian Academy of Sciences, Budapest, Hungary, V. Szechenyi rkt. 3.

Concrete inspection . . . Announcement of a new edition of the "ACI Manual of Concrete Inspection" is made by the American Concrete Institute. Prepared under the direction of J. W. Kelly, author-chairman of the ACI Committee on Inspection, the 232-page, pocket-size manual incorporates constructive suggestions offered during 14 years of continuous service of the original 1941 edition. New material covers such subjects as air entrainment, ready-mixed concrete, and the latest special concrete construction methods. In addition, there has been a general expansion of explanatory matter to make the publication of greater use to the inspector.

Engineering registration . . . An enlarged and revised volume covers examinations given by the State of California for the registration of civil engineers and engineers in training. Problems given between 1940 and 1949 are accompanied by unofficial solutions by the author, and there are examinations only for the 1949 to 1953 period. The 287-page lithoprinted volume may be purchased from the author, August E. Waegemann, 2833 Webster St., San Francisco 23, Calif., for $7 plus California tax, or c.o.d., plus postage.

RECENT BOOKS

A C I Manual of Concrete Inspection

Designed for the use of engineers, architects, and contractors as well as for inspectors, this manual of the American Concrete Institute describes and interprets methods of inspecting concrete construction which are generally accepted as good practice. It is intended as a supplement to the A C I specifications and as a guide in matters not covered in the specifications. (American Concrete Institute, 18263 W. McNichols Road, Detroit 19, Mich., third edition, 1955. 232 pp., $2.50—members $1.50.)

Symposium on Permeability of Soils

The eleven papers (Special Technical Publication No. 163 of the American Society for Testing Materials) presented deal with the principles of permeability testing, the determination of the permeability of different types of soils, and with various related topics. A selected list of references is included. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1955. 136 pp., $3.00.)

Taschenbuch Für Bauingenieure

This standard reference work edited by Ferdinand Schleicher contains the basic material used in all branches of civil engineering. Major sections cover mathematics, mechanics of solids and fluids, strength of materials, wood construction, steel and concrete construction, construction materials, soil mechanics, earthworks, dams and tunnels, highway and railroad construction, water supply, waterways, surveying, city planning. Now in two volumes, the material has been brought up to date and regrouped for more effective use. (Springer-Verlag, Berlin, second edition, 1955. 2 volumes, DM56.-/2 vol.)

Plastics in Building

Reflecting the growing influence of plastics in the building field this conference report of the Building Research Institute presents three introductory papers, seven papers on specific uses such as interior panels, piping, and ducts, two on standards and codes, and four summarizing the conference activities and previewing future uses. There is also a brief report on sprayed-on plastic sheetings. (National Research Council, 2101 Constitution Avenue, Washington 25, D.C., 1955. 149 pp., $5.00.)

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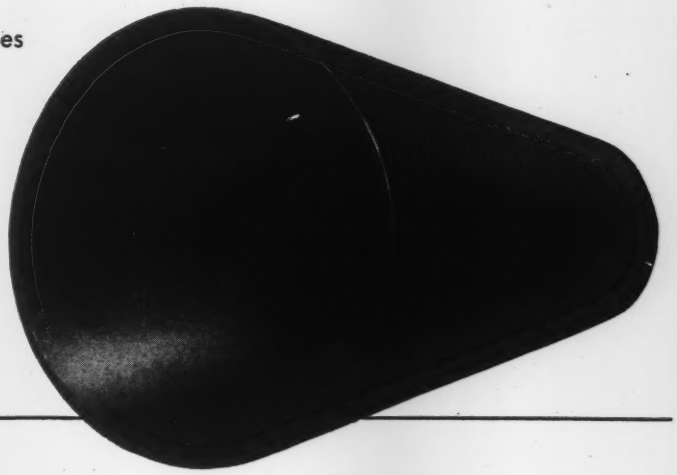

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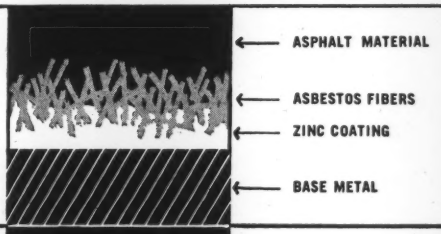

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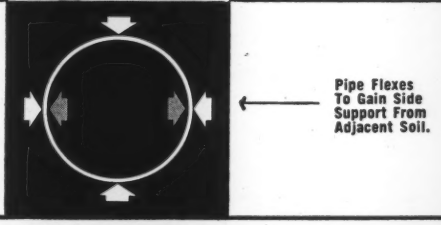

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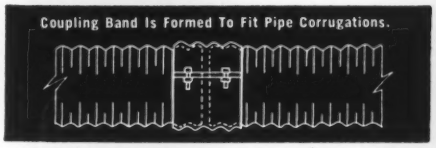

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St. Lawrence Power Project. . .

(This article begins on page 48)

(*Continued from page 52*)

that a solid sheet of ice, rather than ice jams, can form over the forebay area. Channel work is required in three areas: above Iroquois Dam, where the natural rock-weir control will be removed; below Iroquois Dam; and below the Barnhart Island Power Plant.

Channel enlargements may be classified in three general groups:

1. Those required to produce a velocity not exceeding 4 ft per sec at any time in order to meet navigation requirements. These are in the reach from Iroquois Point to Lotus Island, and in the Galop Island reach.

2. Those required to produce a velocity not exceeding 2.25 ft per sec during the ice-forming period. These are in the reaches from Morrisburg to Iroquois, and from Iroquois Point to Lotus Island.

3. Those economically justified for the conservation of power head. These are in the section from the powerhouse downstream to Polly's Gut, in the Cornwall Island reach, and in the tailrace downstream.

The usual backwater computations form the hydraulic basis for determining the extent of channel enlargement required. Because of the complex nature of the branched river channel and the number of islands included, numerical computations were supplemented by extensive model tests at the hydraulic laboratory of the Hydro-Electric Power Commission of Ontario.

Robert Moses is Chairman of the Power Authority of the State of New York; William S. Chapin is General Manager; J. Burch McMorran, M. ASCE, Chief Engineer; and Thomas F. Moore, General Counsel. Richard L. Hearn, M. ASCE, is Chairman of the Hydro-Electric Power Commission of Ontario, and Otto Holden, Chief Engineer. The Canadian members of the St. Lawrence River Joint Board are Lionel Chevrier and R.A.C. Henry, with M. N. Sauer and Brig. Gen. Maurice Archer as alternates; the United States members are Robert T. Stevens and J. K. Kuykendall, with Francis L. Adams, M. ASCE, and Maj. Gen. Charles Holle, M. ASCE, as alternates, and Robert H. Hayes as Chief Engineer. The firm of Uhl, Hall & Rich, an affiliate of Chas. T. Main, Inc., are consulting engineers to the New York State Power Authority.

(This article was prepared from the paper presented by Mr. Rich at the ASCE Annual Convention, before a Power Division session presided over by R. A. Sutherland, Vice-Chairman of the Division's Executive Committee.)

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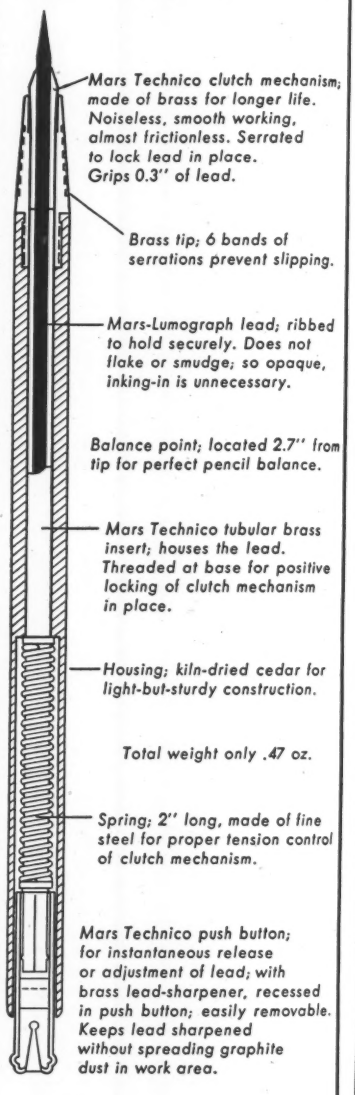
Mars Technico clutch mechanism; made of brass for longer life. Noiseless, smooth working, almost frictionless. Serrated to lock lead in place. Grips 0.3" of lead.
Brass tip; 6 bands of serrations prevent slipping.
Mars-Lumograph lead; ribbed to hold securely. Does not flake or smudge; so opaque, inking-in is unnecessary.
Balance point; located 2.7" from tip for perfect pencil balance.
Mars Technico tubular brass insert; houses the lead. Threaded at base for positive locking of clutch mechanism in place.
Housing; kiln-dried cedar for light-but-sturdy construction.
Total weight only .47 oz.
Spring; 2" long, made of fine steel for proper tension control of clutch mechanism.
Mars Technico push button; for instantaneous release or adjustment of lead; with brass lead-sharpener, recessed in push button; easily removable. Keeps lead sharpened without spreading graphite dust in work area.

Mars-Lumograph lead; finest graphite meticulously graded from EXB to 9H (18 degrees) for better reproduction.

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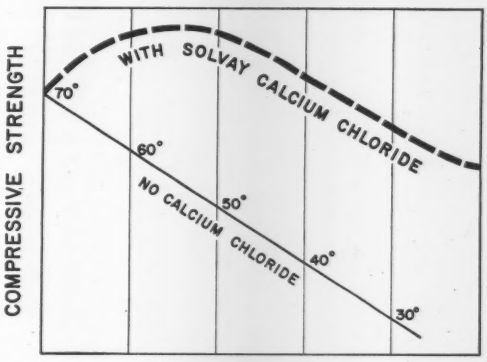

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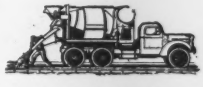

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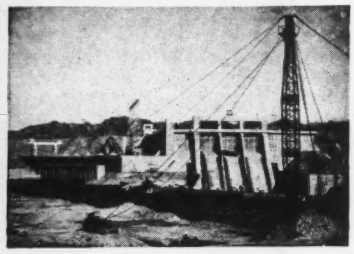

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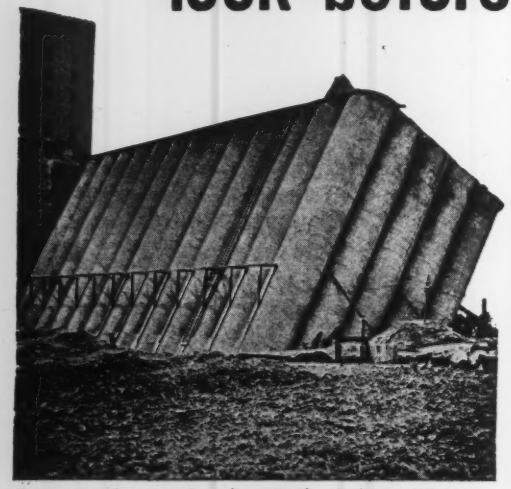

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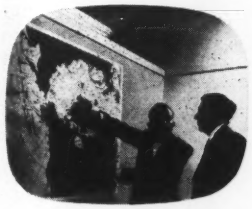
Scholarships and Grants. The Missouri State Highway Commission, in cooperation with the University of Missouri's Department of Civil Engineering, is providing qualified high school graduates in need of financial aid with an opportunity to study at the University toward a degree in civil engineering. The program will permit completing the course in five and a half to six and a half years. Participants will spend alternate periods of academic training in college and on-job-training work. . . . The National Science Foundation's Fifth Annual Graduate Fellowship Program is offering more than 750 fellowship awards for a year of graduate study in engineering and other sciences during the academic year, 1956–1957. Applications may be obtained from the Fellowship Office, National Research Council, Washington 25, D. C. Closing dates for receipt of applications are December 19, 1955, for postdoctoral applicants, and January 3, 1956, for graduate students.

New Courses. The General Education Committee of the Chicago Engineering Societies is conducting a course on "Law for Engineers." Its aim is to state and explain the principles of law which bear most directly upon the engineering profession. Information may be received by writing to the Committee at 84 E. Randolph St., Chicago 1. . . . New evening graduate engineering courses are being held at Stevens Institute of Technology, Castle Point, Hoboken, N.J. . . . The Polytechnic Institute of Brooklyn is sponsoring a four-lecture course on "Design of Thin-Shelled Concrete Arches," given by John J. Hogan, consulting structural engineer for the Portland Cement Association. The dates are November 8, 15, 22, and 29. . . Stanford University's civil engineering department is offering a one-year graduate program directed specifically at construction. Its aim is to give students a fundamental background in subjects important to the industry, including management techniques, law, labor problems, and human relations as well as engineering.

New Buildings. Construction of a four-story research and teaching center at George Washington University will be starting soon. The building—a gift to the University from Charles H. Tompkins, M. ASCE, Washington, D.C., contractor—will be called Tompkins Hall of Engineering. . . Lehigh University dedicated its new Fritz Engineering Laboratory on October 14. Erected by the University with the cooperation of the Bethlehem Steel Co., the laboratory houses a 5,000,000-lb vertical testing machine, the world's largest. Other facilities include a dynamics test bed, and research and testing apparatus in the fields of structural metals, concrete, timber, hydraulics and soils mechanics. Dr. Allen V. Astin, director of the Bureau of Standards, was the principal speaker. . . . Syracuse University dedicated its new $940,0000 engineering building, William Lawyer Hinds Hall, on October 7.

Lockheed diversification in action...

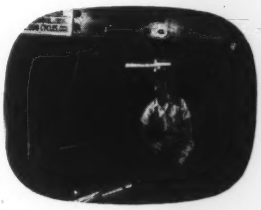
Below: engineers and scientists work on some of the 46 major projects in progress at Lockheed



Operations Research discussion on continental defense

Operations Research openings

Electronics Specialists
Fire Control and Guidance Specialists
Aerodynamics Engineers
Physicists



Fatigue test on Super Constellation skin

Structural Engineering openings

Research Specialists
Structures Engineers
Stress Analysts
Weight Engineers

Hot-air cyclic de-icing test on radar search plane

Thermodynamics openings

Research Specialists
Thermodynamics Engineers
Thermodynamicists

Design study on hydraulic requirements of new transport

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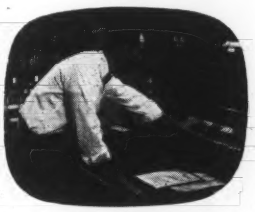
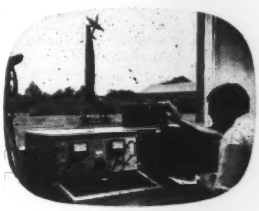
Design positions are open at all levels in controls, electrical, hydraulics, mechanical, power plant and structures fields.



IBM 701 applied to jet transport flutter problem

Math. Analysis openings

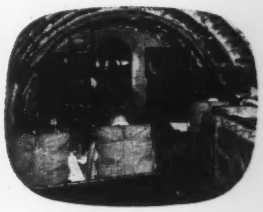
Math. Engineers
Math. Specialists
Math. Analysts



Antenna pattern study on radar search planes

Electronics openings

Electronics Research Engineers
Airborne Antenna Designers
Research Specialists



In-flight test on air speed performance

Flight Test Engineering openings

Flight Test Engineers
Flight Test Analysts
Instrumentation Engineers
Electrical Research Engineers

Aerodynamic meeting on high-speed fighter

Aerodynamics openings

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

ASSISTANT PROFESSOR; A.M. ASCE; married; ten years' experience in teaching structures, surveying, mechanics, etc; ten years' experience in structural design, surveying, and construction; licensed professional engineer and land surveyor. Desires position as professor, associate professor, or as design engineer with consulting firm. C-88.

STRUCTURAL ENGINEER, A.M. ASCE; A.B., B.C.E.; 38; married. Eight years as naval architect on design and stability of ships. Five years as design supervisor on structural steel for transmission lines, switchyards, and power plants. Two years in India as adviser on power plant design. Desires position as structural steel designer. C-87.

STRUCTURAL ENGINEER; J.M. ASCE; M.S., structural analysis; 30; six years' experience in analysis and design of industrial buildings, apartment houses, school buildings, power houses and airport facilities. Eighteen months' experience as field engineer. Registered state of New York. Desires position with architect or consultant in Suffolk County, Long Island, N.Y. C-89.

Positions Available

JUNIOR CIVIL OR MECHANICAL ENGINEER with municipal engineering experience covering water works systems to make surveys and distribution studies and prepare reports. Considerable traveling. Location, various places in the United States. Salary, $3,900–$4,200 a year plus bonus and allowances. W-772.

CIVIL ENGINEERS, 30–45, graduates, for consulting engineering firm specializing in bridge and highway design. Should have three or four years' experience in the consulting or highway field, or bridge work. Prefer registered engineer. Salary, about $7,000 a year. Location, Maryland. W-2017.

CONSTRUCTION ENGINEER, 30–40, civil graduate, with estimating and building construction experience for office and field duties with financial institution. Salary, $6,000–$8,000 a year. Location, New York, N. Y. W-2065.

CONSTRUCTION ENGINEERS, graduates. (*a*) Resident Engineer for airfield construction. Experience required in stabilization of compressible subsoils. Salary, $7,920–$9,360 a year. (*b*) Materials Engineer with wide experience in soil mechanics and working knowledge of concrete and asphalt. Salary, $7,920 a year. (*c*) Materials Engineer with experience in concrete and soils. Salary, $5,400 a year. Free housing. On all positions, transportation provided for employees and families. Contract 18–24 months depending on location. Living costs comparable to United States. Schools with American teachers. Location, Caribbean Area. W-2076.

ASSISTANT OR ASSOCIATE PROFESSOR in sanitary engineering, to take full charge of sanitary laboratory and sanitary instruction. Location, South. W-2080.

ASSISTANT CITY ENGINEER, civil, under 50, P.E., with experience in construction and design. Civil Service tenure. Salary, $7,740–$8,688 a year. Location, Michigan. W-2102-D.

WATER SUPPLY ENGINEER with experience in well-site selection, well drilling, and all phases of development of ground-water supply in arid regions. Salary over $10,000 a year. Headquarters, Rome, Italy. F-2114.

ENGINEERS: (*a*) Construction Managers, experienced, to take charge and handle the construction of a large paper mill. Must have extensive experience in the construction of major and modern paper mill. (*b*) Project Managers, experienced on the construction of steam electric generating plants. Location, South. W-2142.

TEACHING PERSONNEL: (*a*) Professor, 35–45, M.S. degree desirable, but not essential, with teaching and professional experience in civil engineering, to handle undergraduate subjects in at least two subdivisions of civil engineering. (*b*) Assistant Professor, at least 25, with minimum of two years' experience in either teaching or engineering practice, to teach civil engineering subjects. Salaries open. Location, Foreign. W-2151.

ENGINEERS: (*a*) Project Engineer, Structural, heavy construction supervision or administration. Will supervise personnel of construction contractors and prepare reports, etc. (*c*) Office Engineer, 30–45, B.S. in civil engineering or M.E., at least eight years' experience in heavy construction or engineering. Estimate all phases of work, structural, mechanical, electrical, utilities, etc. Prepare all construction project estimates; prepare and execute all construction change orders, etc. (*d*) Facilities Engineer—Architectural, 30–40, degree in architecture or civil engineering, at least five years' of building and plant design in construction engineering. Responsible for civil and architect design work on minor construction and plant maintenance work. Salaries open. Location, New York State. W-2162.

SALES ENGINEER, 27–35, civil graduate, with concrete experience, for technical field work with customers of cement manufacturer. Salary, $4,800–$6,000 a year. Location, Northeast. W-2165.

CIVIL ENGINEERS: (*a*) Civil Engineer with municipal experience desirable, to serve as Assistant Town Engineer. Salary, $5,500 a year. (*b*) Civil Engineer, recent graduate, for municipal work. Salary, $4,500 a year. Location, Connecticut. W-2191.

STRUCTURAL ENGINEER, graduate, with knowledge and training in the field of dynamic analysis of structures to do work in the study of blast effects on shelters and other protective units and in the design of such units to minimize injury to persons and community facilities. Salary dependent on training and experience. Location, Midwest. W-2192.

TOWN ENGINEER, 35–40, civil graduate, with at least five years' public works engineering experience covering municipal buildings, streets, sanitary and water facilities. Salary, $7,500–$8,500 a year. Location, Nassau County, Long Island. W-2204.

STRUCTURAL ENGINEER, DESIGNER AND DETAILERS for work on bridges and industrial structures. Should be graduate engineers or have equivalent training. Salary open. Location, upstate New York. W-2239.

CONSTRUCTION SUPERINTENDENT, Civil Engineer, with experience in the construction of commercial and industrial building in southern Ohio. Opportunity for advancement. Salary open. W-2257-D.

BRIDGE DESIGNERS

WASHINGTON STATE HIGHWAY COMMISSION

C.E. Degree	$380–451
2 yrs. exp.	$414–492
3 yrs. exp.	$432–514

These are permanent, Merit System positions in Olympia. 40-hour week, retirement system, liberal vacation and sick leave. Expanded highway program offers excellent opportunities for those interested in career employment. Write Personnel Officer, 220 Transportation Building, Olympia, Washington.

STRUCTURAL DESIGNERS & DETAILERS

Prefer CE or Arch E with several years' experience in bridges, industrial buildings, or pressure vessels and heavy ducting. Will consider lesser experience with good educational background in structural analysis.

Unusual engineering opportunities exist in our well established firm in connection with the design, construction supervision and inspection of a wide variety of engineering projects in both concrete and steel. Included are bridges, industrial buildings, advanced test facilities and other construction of an industrial nature, and various types of highway work.

Please write fully to—

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Consulting Engineers

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STRUCTURAL DESIGNERS

Structural Designers who want greater opportunities and diversified experience are needed by a large, progressive engineering company celebrating its fiftieth year of service to industry.

Permanent Positions for Qualified Personnel

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Promotion from Within the Company

Please send resume to:

Director of Personnel

THE RUST ENGINEERING CO.
575 Sixth Avenue
Pittsburgh 19, Pa.

Engineer-Laboratory Director

degree and supervisory experience required. Advanced soil mechanics degree desirable. Must have experience testing soils, concrete, steel, and general construction materials by standard procedures. Location, Gulf Coast. Send complete resume and salary requirements to:

Box 255
CIVIL ENGINEERING
33 West 39th St.
New York 18, N. Y.

CHIEF CHEMIST

degree and experience in chemical testing of construction materials, cement, asphalt, metals by ASTM & AASHO. Knowledge in use of Spectrophometer desirable, not essential. Location, Gulf Coast. Send complete resume and salary requirements to:

Box 256
CIVIL ENGINEERING
33 West 39th St.
New York 18, N. Y.

SURVEYOR-ENGINEER, not over 35, preferably married, experienced as chief of party or instrumentman. Capable of keeping good field notes, fair draftsman. Must be graduate or have sufficient experience in surveying and general civil engineering, to carry out instructions in field and office on land surveys, minor design problems on highways, drainage and small structures. Draft exempt. Salary open. Location, Florida. W-2268.

INSTRUCTORS OR ASSISTANT PROFESSORS, Master's degree desired, to handle applied mechanics and strength of materials, hydraulics and surveying. Salary, $4,200–$4,800 for nine months. Location, Southwest. W-2269-S.

GENERAL CONSTRUCTION SUPERINTENDENT, civil graduate preferred, to administer and supervise large project. Must be familiar with all building trades. Project involves large shopping center in New York Metropolitan Area. One to two years' work. Salary open. W-2280.

CITY PLANNING ASSISTANT, civil graduate, with design and layout of city planning covering sewer and water systems, streets, highways; interested in preparation of reports. Salary, $5,000–$6,000 a year. Location, Northern New Jersey. W-2294.

HIGHWAY ENGINEER, registered civil engineer, specializing in highway and turnpike design. Will head a newly formed highway engineering subsidiary of a well established eastern engineering and construction firm. Salary open. W-2297.

AIRPORT MASTER PLANNER for eastern architect-engineering firm. Registered architect or civil engineer with extensive experience in master planning of complete airports. Salary open. W-2302.

DISTRIBUTION APPLICATION ENGINEER, civil graduate; up to 35. At least two years' experience in construction, deck or railroad work. Have a knowledge of trestle or deck design. Duties will be promoting use of pressure-treated timber by calling on architects and engineers. Extensive travel. Car required. Salary, $6,600–$7,800 a year. Location, California. C-3881.

CITY ENGINEER, California registration required. Experienced in water, street and sewer design and construction supervisor preferred. Salary open. Location, California. S-550.

DAM ENGINEERS, minimum of four years experience in construction and/or design of dams, preferably with a working knowledge of soil mechanics and concrete control for duties involving review of plans and specifications, report writing, field investigation and inspeetions, with some travel and public relations. Opportunity for administrative experience and advancement.

HYDRAULIC ENGINEERS, experienced in design and preparation of contract plans for flood control projects. Will be engaged in long range flood control program. Opportunities for gaining broad experience and for advancement.

LOCATION. Pennsylvania. Give full details of experience, education, age, salary expected and references.

ADDRESS replies to Box 258
Civil Engineering
33 W. 39th Street,
New York 18, N. Y.

Applications for Admission to ASCE, Sept. 10–Oct. 8, 1955

Applying for Member

ORRIS LESTER ADKINS, So. Charleston, W. Va.
SHANTILAL MULJIBHAI AMIN, Bombay, India.
HAROLD KESSLER BRICKEY, Denver, Colo.
JOHN JOSEPH BUGAS, Denver, Colo.
ARNOLD GRAY CAREY, Boston, Mass.
JAMES CLIFFORD GARNETT, Victoria, B.C., Canada.
CHARLES SAMUEL GOODE, El Cajon, Calif.
RUSSELL WILLIAM HART, Kansas City, Mo.
FRANK BRUNO HOEHL, Wheeling, W. Va.
JOSEPH EDWIN HOVAS, Augusta, Ga.
KENNETH AUSTIN JEWELL, Evanston, Ill.
LEONARD NIELSEN JORGENSEN, Salt Lake City, Utah.
CHARLES FRANKLIN KNOWLTON, JR., Beverly Hills, Calif.
JYOTI PROSAD MAZUMDAR, West Bengal, India.
WILLARD PAUL MCCRONE, Galveston, Tex.
FREDERICK WILLIAM RICE, New York, N. Y.
FRANK HERMAN SCRIVNER, Austin, Tex.
LAWRENCE SHERMAN, Paris, France.
MANDRUP SKEIE, Philadelphia, Pa.
CARL BENNER SMITH, Columbus, Ohio.
JAMES JUSTIN TRINDLE, Van Nuys, Calif.
NOLAND VARLEY, Oak Ridge, Tenn.
PAUL CARROLL VICKERS, South Charleston, W. Va.
WILLIAM TURNER WALLIS, JR., West Palm Beach, Fla.

Applying for Associate Member

HARRY LEE BEEMAN, Dallas, Tex.
TULLIO JOSEPH BORRI, Dunbar, W. Va.
LAWRENCE JAMES BUCKLEY, East Haven, Conn.
BENJAMIN JOSEPH CAMPAGNA, Newark, Del.
SAI PAK CHAN, Denver, Colo.
DONALD JOHN CIER, Milwaukee, Wis.
JOHN BAINES COLTON, New York, N. Y.
HAROLD OSBORNE CRAIG, San Francisco, Calif.
JAMES MADISON CUTTS, Washington, D. C.
EUGENE ROBERTS DAVIS, Pittsburgh, Pa.
JOHN ANTHONY DE MONTE, Boston, Mass.

ENGINEERING OPPORTUNITIES

For young graduate Civil Engineers interested in future as highway design engineers. Training under competent highway specialists in expanding well-established firm.

Permanent positions now available. Some highway experience preferred but not required.

Excellent starting salaries, moving allowance, Blue Cross, paid vacations and holidays; sick leave, and voluntary employee benefit and retirement plan.

Write for application form.

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ENGINEERS

CIVIL ENGINEERS

MECHANICAL ENGINEERS

ELECTRICAL ENGINEERS

Caterpillar Tractor Co., the world's leading manufacturer of diesel tractors, motor graders, engines and earthmoving equipment, has openings for engineers in their sales departments. Applicants for these responsible positions should have engineering degrees or considerable practical experience. Civil, mechanical and electrical engineers are desired. Security and advancement are certain for qualified men and starting salaries are well above the industry average. Applicants should send full particulars of experience and education to: Sales Promotion Department, Caterpillar Tractor Co., Peoria, Illinois.

CATERPILLAR TRACTOR CO.

civil estimator

Large New York engineering and construction firm has staff opening for Chief Civil Estimator. Should be graduate civil engineer with experience in power plant field. Particularly interested in a man with field engineering or construction supervisory experience on hydroelectric developments. Should be capable of heading up civil estimating group. Excellent opportunity for qualified man. Please submit resume of education, experience and personal data.

BOX 259

CIVIL ENGINEERING

33 W 39TH ST.

NEW YORK 18, N. Y.

HOWARD MEADE EICHSTAEDT, San Rafael, Calif.
JAMES KUYKENDALL FARLEY, Aiken, S.C.
JOHN BILLIE GREGORY, Indianola, Nebr.
HIDEO HAYASHI, Maui, Hawaii.
RAYMOND LUTHER HERMAN HUEBSCHER, Los Angeles, Calif.
DAH HSUAN LEE, New York, N.Y.
JAMES JOSEPH LEE, Riverdale, N. Dak.
WILLIAM JOHN LINDH, JR., Alhambra, Calif.
HERBERT LEROY LOBDELL, Montclair, N.J.
JOHN EDWARD LYONS, Zulia, Venezuela, S.A.
KENNETH DEARDORFF MCCALL, El Paso, Tex.
SEARS WOOD MERRICK, Denver, Colo.
JAMES PARR MERRIMAN, Houston, Tex.
HIROSHI MORI, Oakland, Calif.
CORNELIUS NEUFELD, Montreal, Que., Canada.
EDWARD OBLER, Scarsdale, N. Y.
ERNEST JOHNSTONE PARKIN, Washington, D.C.
ALDO PARMEGGIANI, Monrovia, Liberia.
JAMES PROWANT SALE, Cincinnati, Ohio.
REGINALD FRANK SHAPCOTTE, Vancouver, B.C. Canada.
MARTIN ARNOLD SILBART, Chicago, Ill.
KENNETH ERIC SNELSON, Berkeley, Calif.
GEORGE P. STANLEY, Lafayette, Ind.
HENRIQUE TRUTSCHEL, Venezuela, S.A.
COURTNEY VALK, Savannah, Ga.
JOHN CLIVE VIRTUE, London, England.
HARRY BAKER WALL, Salt Lake City, Utah.
CHESTER JOHN WOODS, Seattle, Wash.
DONALD JAMES YARK, Toledo, Ohio.

Applying for Junior Member

WILLIAM HOWE ALCOKE, Lexington, Ky.
VICTOR BATTANI, JR., San Bruno, Calif.
NIRMAL SINGH DHILLON, Baltimore, Md.
JAMES ROBERT DOYLE, Baytown, Tex.
JAMES DONALD FRITZ, Oakland, Calif.
BEVERLY HAVEN HOFFMASTER, Sacramento, Calif.
EDWIN FRANCIS HUMM, JR., Syracuse, N.Y.
SUSUMU KARAKI, Kansas City, Mo.
PETER FRANCIS MENOU, San Francisco, Calif.
PALMER NORSETH, Portland, Ore.
CHARLES JOSEPH PURCELL, Montreal, Que., Canada.
BHUPALAM RAMAMURTHY, Bihar, India.
EDWIN NELSON SEWARD, San Fernando, Calif.

Applications for Junior Membership from ASCE Student Chapters are not listed.

Structural Engineer

Graduate civil engineer interested in structural design engineering. Experience not required.

Excellent opportunity with consulting engineering firm. Liberal benefit plans and good working conditions. Location Middle West.

Send resume of education and experience with salary requirements to:

Box 260

CIVIL ENGINEERING

33 West 39th Street

New York 18, N. Y.

AIRCRAFT ENGINEERS

With Experience

WANTED AT

GRUMMAN

LAYOUT DESIGNERS
Airframe Structures

FLIGHT TESTING
Planners
Analysts

HYDRAULICS
Systems Design
Testing

STRUCTURES
Stress Analysis

RESEARCH
Computer Engrs. Digital or Analog
Vibration & Flutter Engrs.
Dynamic Analysis—Systems Engineers

ARMAMENT INSTALLATION
AERODYNAMICS
INSTRUMENTATION
TOOL DESIGNERS

Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

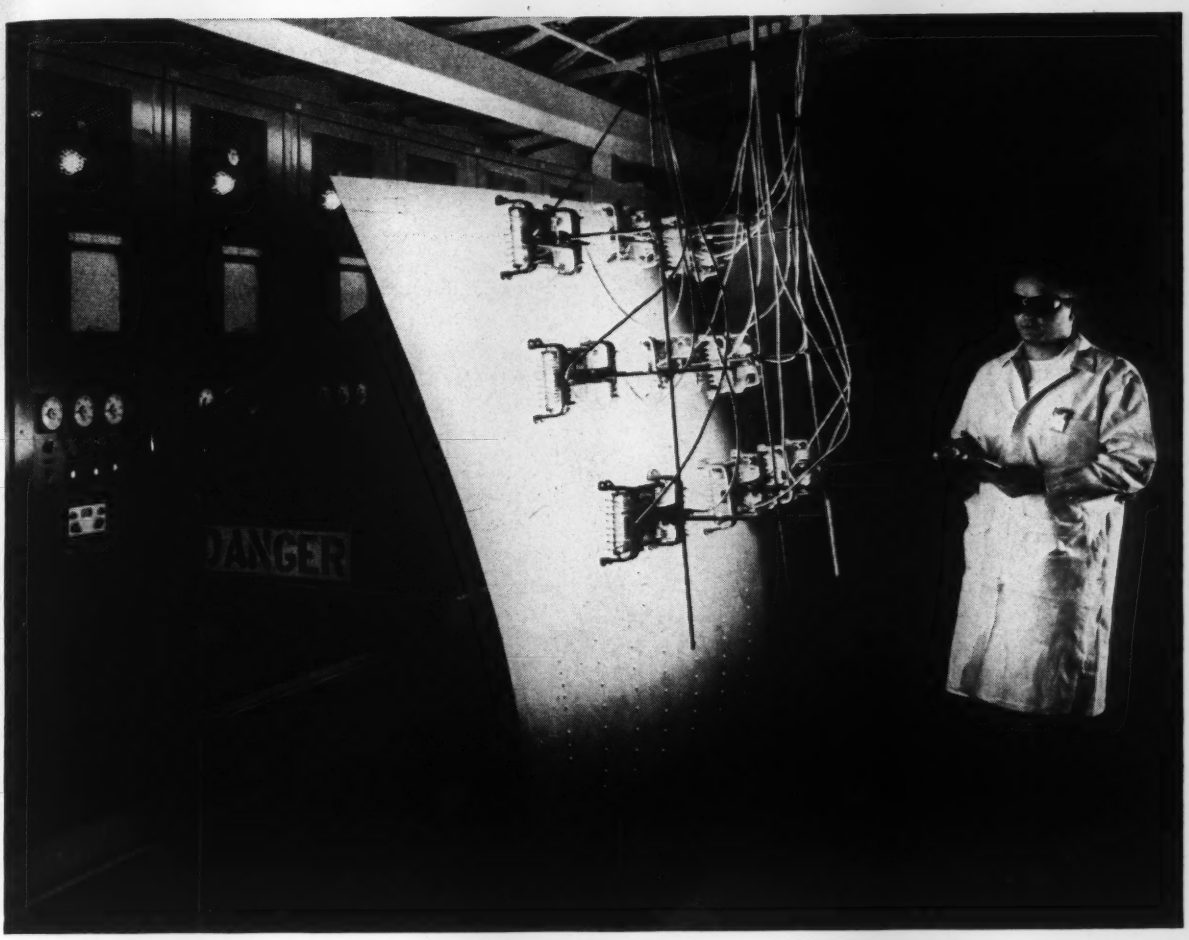
Proof of U. S. Citizenship Required

APPLY IN PERSON OR SEND RESUME TO:
Engineering Personnel Dept.

INTERVIEWS AT
Employment Office
South Oyster Bay Road
North of Railroad

Monday thru Friday
8:30–11:30 AM; 1:30–3:30 PM

GRUMMAN AIRCRAFT
Engineering Corp.
Bethpage, N. Y.



How Boeing civil engineers help penetrate the "thermal thicket"

When this bank of lights is turned up to its full 288 KW, skin temperature of the aluminum panel reaches 700° F in a few seconds. Data from this and many other research projects help Boeing civil engineers create structures able to withstand the sudden temperature rise of tomorrow's fast-accelerating planes and missiles.

There are more than 500 civil engineers at Boeing. They work closely with Boeing engineers in other fields to meet the challenges of future flight. And more civil engineers are needed for truly creative Boeing projects. They will join research, design and production teams in developing new uses for titanium, magnesium, plastics, and other new materials, and in thermo and fluid dynamics, stress analysis, and other specialties for high-performance aircraft of the future.

Boeing engineers are investigating problems never faced before. Often they design their own test equipment, like the "quick heat" facility shown here. Other Boeing-designed equipment includes electronic computers of the latest type, a new supersonic wind tunnel capable of velocities up to Mach 4, test chambers to produce extremely low temperatures and atmospheric pressures and the superbly-appointed, multi-million-dollar Flight Test Center.

A great and ever-growing team of engineers operates these test facilities and is now creating from resulting data the very high-speed planes and missiles of a few years hence. Because of Boeing's solid growth, there are more than twice as many engineers with the company now than at the peak of World War II. A quarter of them have been with Boeing more than 10 years and some for more than 30.

This indicates the security and growth potential of a job with Boeing. If *you* want to be a member of aviation's top creative team, it will pay you to investigate the advantages of a Boeing career.

JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Co., Dept. D-45, Seattle 14, Wash.

Please send further information for my analysis I am interested in the advantages of a career with Boeing.

Name _____

College(s)_____ Degree(s)_____ Year(s)___

Address _____

City_____ Zone___ State_____

Phone number_____

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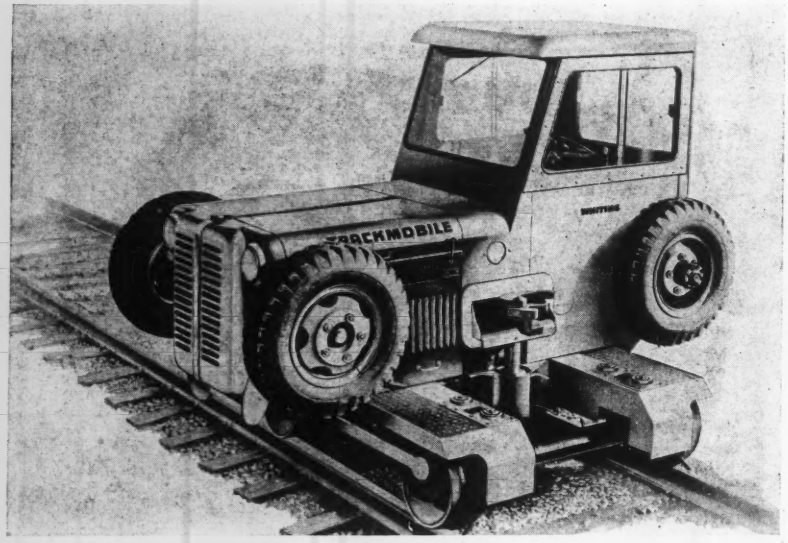
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS



Versatile Trackmobile

A VERSATILE, NEW HEAVY-DUTY TRACKMOBILE that hauls, switches and spots railroad cars is now on the market. Designed for use on factory sidings, mines and quarries, grains storage depots and other industrial trackage, the heavy-duty Trackmobile can pull heavily loaded railroad cars, switch, spot, and make up strings of cars. Operating on both road and track, it travels on roadways, or across track, on four pneumatic wheels. When astride a track, the automotive-type wheels are retracted and the machine rests on its steel rail wheels, ready for track operation. This conversion from road to rail wheels takes only 90 seconds. All controls including those for positioning, raising and lowering the automotive-type wheels, and coupling and uncoupling, are located in the cab. The cab is elevated and enclosed in glass to provide 360-deg visibility and all-weather operation. The Trackmobile is driven by a powerful V-8 industrial engine, has a tractor-type suspension to protect against shock when crossing ungraded track, and its all-welded frame is strong and ruggedly built to withstand hard, continuous operation. Built for years of use, it requires a minimum of maintenance attention. **Whiting Corporation, CE-11-118, 157th & Lathrop Ave., Harvey, Ill.**

Stabilized Aggregates Mixing Units

A NEW DELIVERY CONVEYOR ATTACHMENT that thoroughly mixes water and calcium chloride with aggregate, before it is discharged from surge bins or gravel plants into the truck body has been announced. Crushed aggregates mixed with water and calcium chloride provide a gravel or crushed rock road surface that is free from dust, that compacts to a smooth hard surface, and remains relatively stable. The mixing unit eliminates the need of other spraying equipment on the road bed and provides more accurately controlled proportions than with surface-mixing methods. **Iowa Manufacturing Company, CE-11-118, Cedar Rapids, Iowa.**

Sluice Gate

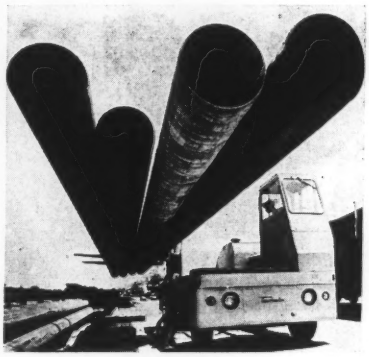
A SLUICE GATE, which allows more flow yet insures closure against flow in either direction, represents the first basic sluice-gate improvement in years. The frame has been lowered so that the opening is flush with adjacent chamber floors or with the natural bottom floorline. Since the gate invert can be located level with the bottom of the channel, engineers are assured of new flexibility when planning water control projects. Advantages of the flush bottom closure arrangement are numerous. There is less turbulence at the bottom where head is greatest so smoother flow is possible, and there is no barrier to accumulate silt and trash. The unit is of cast iron bronze-mounted construction. **Rodney Hunt Machine Company, CE-11-118, Orange, Mass.**

Stud Driver

A NEW "DOUBLE-BARRELED" POWER-ACTUATED TOOL for fastening structural material to steel and concrete is now available. The stud driver has interchangeable barrels which adapt the tool to standard or heavy-duty jobs, delivering an impact of the desired force. Each power load is designed for proper penetration of structural materials. Straight driving is made easy by a design feature that renders the tool inoperable if it is inclined at more than a minimum safe angle to a smooth work surface. Unusual features of the new tool are its flexibility, speed, and ease of handling. **Remington Arms Company, CE-11-118, Bridgeport, Conn.**

Self-Loading Truck

A NEW TYPE OF INDUSTRIAL TRUCK is equipped with facilities for loading itself. By combining the qualities of several different types of equipment, the new unit enables handling of long loads like lumber, structural steel, multiple



Traveloader

pallets, and pipe, with less men and less equipment. The Traveloader stacks up to 12 ft, like a fork truck; carries its loads lengthwise, like a straddle carrier; and delivers with the speed and road-ability of a highway truck. **Baker-Raulang Company, CE-11-118, Cleveland 2, Ohio.**

Diamond Bit Masonry Drill

A NEW SELF-SHARPENING DIAMOND BIT masonry hand drill, known as the Model A-1 Hanmole, is light in weight, operates on standard 110-v power, and has high speed (3,200 rpm). It is equipped with a

special integral water injection system which forces water down the center of the drill bit to act as a cooling agent. Unlike a water swivel attachment for an electric drill, the Hanmole features one complete compact unit designed especially for the hand operation of cutting holes into glazed tile, brick, concrete, granite, marble and other hard building materials. Any standard faucet is adequate for the water supply, though a lightweight pressure tank capable of supplying water for 30 min of drilling is available for outside jobs. **Molco Drilling Machines, Inc., CE-11-118,-19, 1100-20th St., N.W., Washington 6, D.C.**

Roller Power Brakes

THE FIRST APPLICATION of power brakes to three-wheel road rollers has just been announced. Tapered roller bearings on both the guide and drive rolls provide true rolling motion, easy adjustment, and minimum maintenance. The vacuum hydraulic-powered brakes on both the drive rolls, and a mechanical parking brake mounted on the transmission assure complete braking control at all times. In addition to the four-speed transmission drive, a torque converter is also available as optional equipment. **Buffalo-Springfield Company, CE-11-119, Springfield, Ohio.**

Lifting Hook

A NEW PATENTED HOOK is pneumatically operated and electrically controlled. It can be operated by push button from the cab of the crane. Especially suited to handling concrete buckets on construction work, the heavy-duty all-welded and reinforced hook is also useful for many other lifting jobs. Made in 6-ton and 12-ton sizes, the unit is safe and positive in action —cannot open under any load within its capacity. The jaws open wide for easy pick-up and overlap in closing. **Gar-Bro Manufacturing Company, CE-11-119, 2415 East Washington Blvd., Los Angeles, Calif.**

Arc Proofing Process

ASBESTOS FELT AND FIBERGLAS CORD are replacing a mixture of sand and cement for arc proofing high-tension cables. Use of these materials has resulted in considerable labor savings on the job. An undercoating of asbestos is first applied in 10-ft lengths. An outer layer of impregnated asbestos follows and is secured by Fiberglas cord, which can best withstand heat from arcing or accidental fire. No failures from arcing communication have been reported since these materials have been in use. **Owens-Corning Fiberglas Corporation, CE-11-119, Toledo 1, Ohio.**

YOUR BEST BET FOR PUSH-PULL VENTILATION

In underground construction, Naylor offers the most practical push-pull ventilating service.

The combination of light-weight Naylor Spiralweld pipe and the Naylor low pressure Wedge-Lock coupling provides a system with these outstanding performance advantages.

Lines can be made up quickly — faster than by any other method. The coupling provides remarkable accessibility. Space on only one side of the pipe is required for connection. The compact design of this coupling method permits the line to hug the walls in tunnels or wherever space is limited. With each joint of pipe the same length, it is a simple matter to replace any section at any time.

For the complete story, ask for Bulletins No. 507 and No. 514.

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Eastern U. S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

The man behind the gun will tell you...

WHITE GIVES YOU

greater, longer-lasting precision...

Shown, model 7014 with "A" standard. Model 7020, same unit with "U" standard, also available.

yet costs less than other quality engineers' transits

LIKE every White quality-built instrument, these engineers' transits give you greater dollar-for-dollar value than any other comparable unit.

For example: White uses a recently-developed Swiss Dividing Engine to cut graduations into solid silver. This insures super-precision from the beginning, safeguards it through more years of hard field usage.

In addition, White engineers' transits give you internal focusing, covered leveling screws and coated optics. These and a host of other design and operating features combine to give you a transit unsurpassed for ease, speed, accuracy, economy and long-lived dependability. Write for Bulletin 1053 and the name of your nearest dealer. DAVID WHITE COMPANY, 359 W. Court Street, Milwaukee 12, Wisconsin.

DAVID WHITE COMPANY

We offer expert REPAIR SERVICE on all makes, all types of instruments

EQUIPMENT, MATERIALS, and METHODS

(continued)

H-5 Hydrocrane

Hydrocrane

THE NEW ALL-HYDRAULIC H-5 HYDROCRANE is a light, high speed truck crane. Extremely maneuverable and mobile, the H-5 can be used profitably for high lift, close quarter erection; heavy bucket work, indoor jobs, and precision materials handling assignments. Completely new from outrigger feet to boom tip, it is designed for mounting on either a new or used conventional motor truck, eliminating any need for a crane carrier. An outstanding feature of the H-5 is its capability, depending on truck selection, to conform with state highway restrictions regulating width and height. It has an 18,000-lb maximum lift; can be equipped with a standard 2-piece boom, telescoping from 24-ft to 36-ft long, or with an optional high-lift, 3-piece boom, extendible from 38-ft to 50-ft long. With its boom resting over the truck cab, the compact crane moves quickly and smoothly through city traffic, can travel at speeds up to 50-mph along open highway. The self-powered Hydrocrane is equipped with a 75-hp power plant mounted on the upper deck. **Bucyrus-Erie Company, CE-11-120, South Milwaukee, Wisc.**

Bridge Resurfacing

THE PROBLEM OF RESURFACING A CITY STREET which also happens to be the world's widest bridge was solved by the use of corrugated steel flooring in a project lead by Charles R. Waters, New York State District Engineer at Buffalo.

The structure on Main Street in Lockport, N. Y., a part of New York State Route 31, is actually a framing of 3-hinged steel arch girders and transverse floor beams carrying a decking over the New York State Barge Canal.

In order to afford Uniform bearing for the 7 ga., 2 in. deep corrugated steel flooring, new stringers were welded to the floor beams. To eliminate overhead painting after installation, the plates were laid bottom up, beforehand, and two coats of black paint were applied. A coating of asphalt emulsion was given the entire top of the structural plate flooring. The first of two courses of MX-asphalt concrete was then placed to fill the valley corrugations completely and densely. **United Steel Fabricators, Inc., CE 11-120, Wooster, Ohio.**

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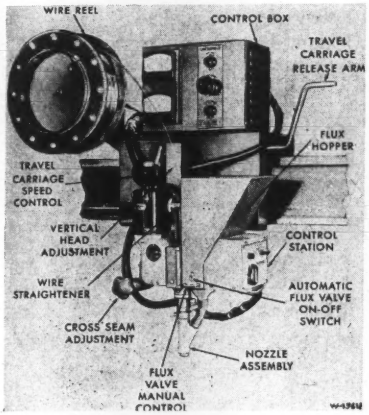
EQUIPMENT MATERIALS and METHODS

(continued)

Welding Heads

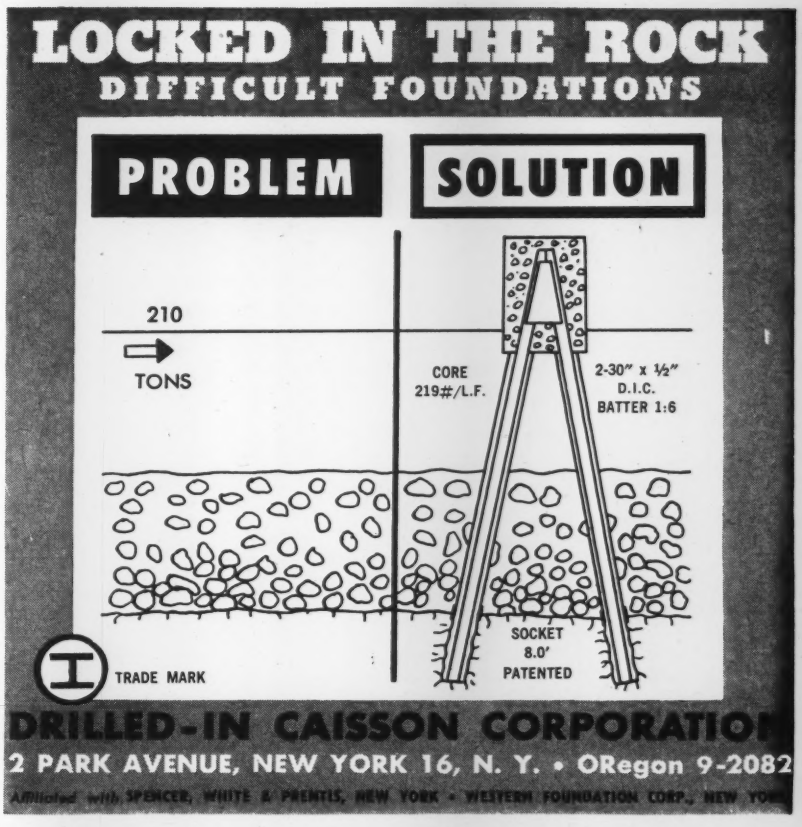
A COMPLETELY NEW LINE of equipment for hidden or submerged arc welding has been developed to give complete flexibility to automatic equipment in meeting requirements for any type of job. Three new welding heads offer to users a choice of either AC or DC current, field or shop welding, and constant potential or variable voltage power source. New operation controls permit a choice of instantaneous starting, hot for intermittent welding or cold for precision starting; a selection of variable inching speeds, slow or fast, away from or to the work; and a choice of carriage operation to give stand-still starts, flying starts or manual control. These new features of the heads can be combined to give an almost unlimited selection providing the best set-up for every job. All controls are simple, using only switches and relays so that any electrician can service the equipment. Field operation is possible from engine-driven welders without additional line power being needed. **The Lincoln Electric Company, CE-11-121, 22801 St. Clair Ave., Cleveland 17, Ohio.**

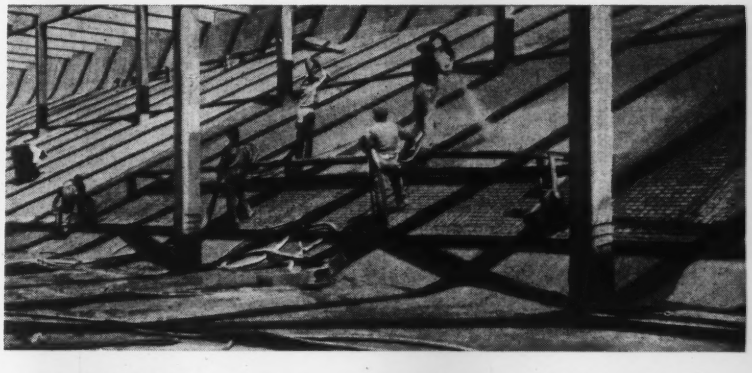


Complete New Line

Planetary Cabler

A REVOLUTIONARY NEW AUTOMATION MACHINE which can produce special electronic cable has been placed on the market. The new machine successfully fabricates intricate cables from fragile strands of conductors, delicate coaxial circuits, and power leads into manageable cable length.





"GUNITE" Lining Restores Reservoir

When the old, open Ballou Park Reservoir at Danville, Va., was improved and covered in 1948, excessive leakage of the old brick lining was stopped with reinforced "GUNITE." The photo shows details of the process. After concrete columns to support the roof were placed, wire mesh reinforcing was laid and the entire reservoir was "GUNITED." Note that the reinforcing and "GUNITE" were carried over the column footings and up the columns approximately three feet to prevent leaking at those points.

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin B3000. We will gladly send a copy at your request. On your letterhead, please.

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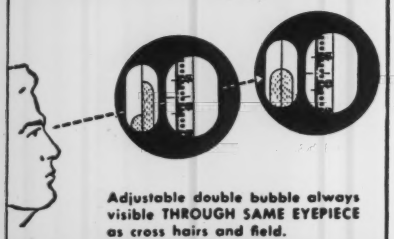

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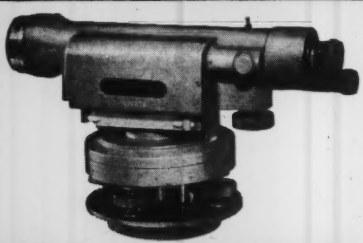

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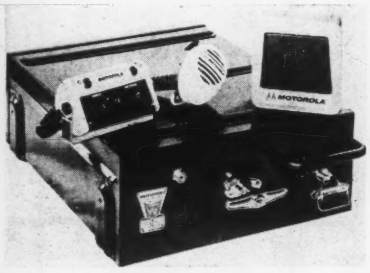
EQUIPMENT MATERIALS and METHODS

(continued)

Designed to supply complex reliable cables in prototype or production runs, the planetary cabler is considered the solution to many current problems in the field of automation. **Douglas Roesch, Inc., CE-11-121,-22, Cable Division, 2200 South Figueroa St., Los Angeles 7, Calif.**

Radiophone

THE NEW LOOK and improved sound in mobile equipment are featured in a complete line of two-way radio units. The radios operate from either a 6 or 12-v



Twin V Unit

battery, and incorporate major innovations improving receiver sensitivity, noise suppression, and voice frequency reproduction. Improved fringe area reception with greater range are obtained through the use of new circuits and new tube types. Both ignition noise from today's high-powered engines and electrical hash are effectively countered by ingenious new circuitry. **Motorola Communications and Electronics, Inc., CE-11-122, 4501 W. Augusta Blvd., Chicago 51, Ill.**

Draft-o-Lamp

A NEW LAMP for lighting drafting and drawing boards of architects and draftsmen illuminates the entire working area with 100-ft candles, and provides perfect shadowless light even on the corners of the board. Designed for use with two 40-w fluorescent lamps, it is 4-ft long and adjustable for height. Freedom from glare and the absence of heat radiation make for comfortable working conditions. Made with a heavy cast base, the Draft-o-Lamp clamps on the back of any drafting board, where it is out of the worker's way. **The Midwest Lighting Products Company, CE-11-122, P. O. Box 536, Cleveland 7, Ohio.**

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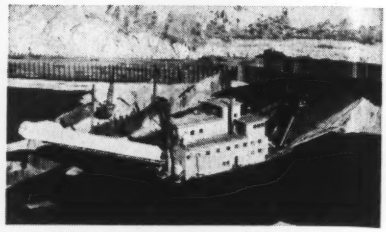

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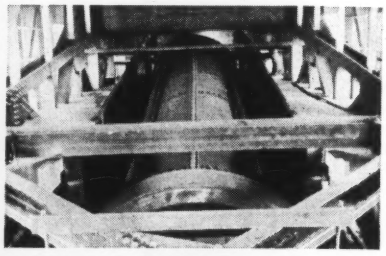

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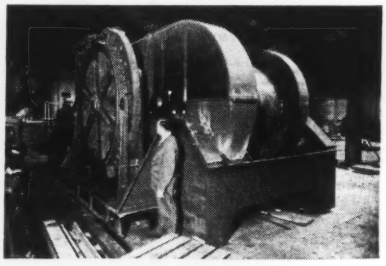

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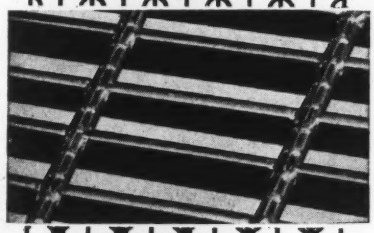

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EQUIPMENT MATERIALS and METHODS

(continued)

Cross-Country Freight Train

THE DEVELOPMENT OF a new cross-country freight train has been announced. Travelling on huge rubber tires instead of rails, each car is self-propelled with all-wheel drive, rather than pulled by a single lead engine. Every wheel of each car has an individual electric motor tucked into its center. The size of the tires range up to ten ft tall and four ft wide offering greater ground contact. Flexibly-mounted

Unique Train

axles adapt the trains to rocky, rough terrain. A unique steering arrangement assures that each car will follow in the identical tracks of the first car. The lead car contains an operator's cab seating seven, a fuel tank, and two engines with generators for the electrically-driven wheels.

The freight train is especially designed for use by heavy construction industries for transporting cargoes and equipment in such impenetrable regions as jungles, deserts, the frozen regions of the Arctic, and other underdeveloped areas. **R. G. LeTourneau, Inc., CE-11-123, 2399 South MacArthur, Longview, Texas.**

Turbocharged Diesel Tractor

INTRODUCTION OF A TURBOCHARGED DIESEL ENGINE rated at 165-hp for the Michigan Model 175A makes it the world's most powerful rubber-tired tractor shovel, easily able to operate at high altitudes with ample power. The turbocharger uses hot exhaust gases to drive a turbo-compressor, which packs air into the cylinders to improve combustion and boost power. The tractor, with four-wheel

(*Continued on page 124*)

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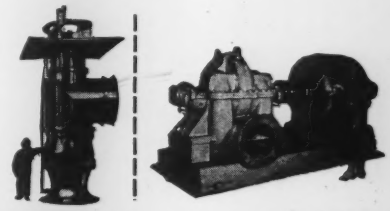

VERTICAL AXIAL FLOW FOR CIRCULATING CONDENSER COOLING WATER

DUAL VOLUTE FOR MUNICIPAL WATER WORKS

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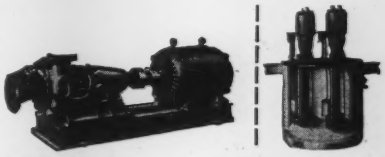

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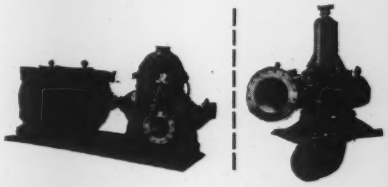

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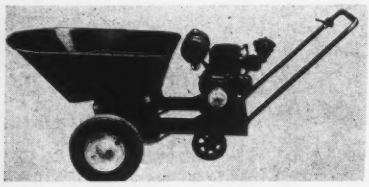
EQUIPMENT MATERIALS and METHODS

(continued)

drive and rear-wheel steering, features a torque converter, power shift transmission, and planetary-wheel drive axis. Elimination of the clutch removes the chief cause of both operator fatigue and maintenance problems. Model 175A has four forward and reverse speeds, with a maximum of 27-mph. **Clark Equipment Company, CE-11-123,-24, Construction Machinery Division, Benton Harbor, Mich.**

Power Wheelbarrow

AN ALL NEW POWER WHEELBARROW is being introduced in two sizes. The junior size is powered by a 2-hp gasoline engine and the senior size by a 4-hp gasoline engine. Outstanding features include a self-tipping tray that is easily controlled by the operator at the handle.



Throttle Controlled

Easy throttle control is also at the operator's fingertips. Both units are capable of carrying their full capacity up a 25-deg incline. The wheelbarrow is ideal for carrying dirt, rock, cement and all other bulk material. It is also available with a flat pallet for carrying either cinder block, brick, and insulation material. **United Sales Company, CE-11-124, 6 Whitewood Ave., Staten Island 10, N.Y.**

Sandstorm Pipe Cleaner

A NEW TOOL is the first successful application of the sand-blasting principle for cleaning the interior diameter of pipes and tubes. It cleans by whirling sand or other abrasive substance under great pressure inside the pipe. A conical diverter disperses the abrasive material over 360-deg, making it unnecessary to rotate the cleaner to turn the pipe. Available in four sizes, the sand-blaster cleans interior surfaces of all pipes quickly, and inexpensively without the use of skilled labor. It removes alkali deposits and salts of all corrosive liquids, as well as all pitting due to erosion. **J. C. Fennelly Company, CE-11-124, San Francisco, Calif.**

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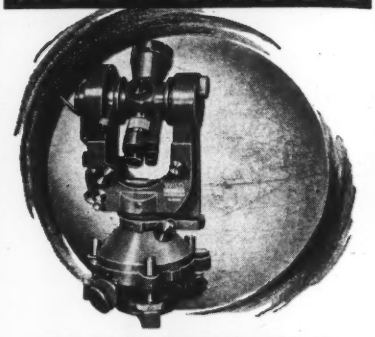

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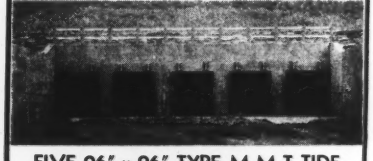
TIDE GATES



FIVE 96" x 96" TYPE M-M-T TIDE GATES INSTALLED NEAR WILKES-BARRE, PA.

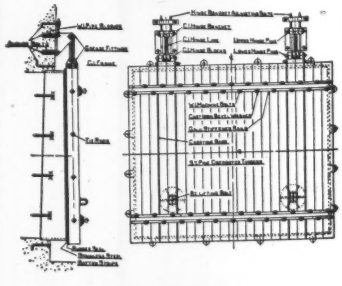


FIG. 9320 SHOWING TYPICAL CONSTRUCTION.

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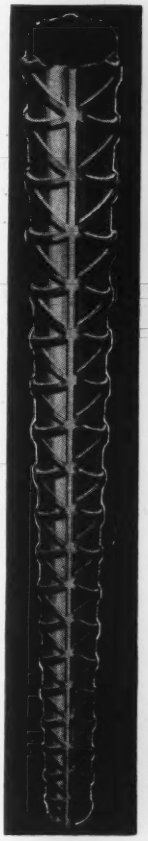
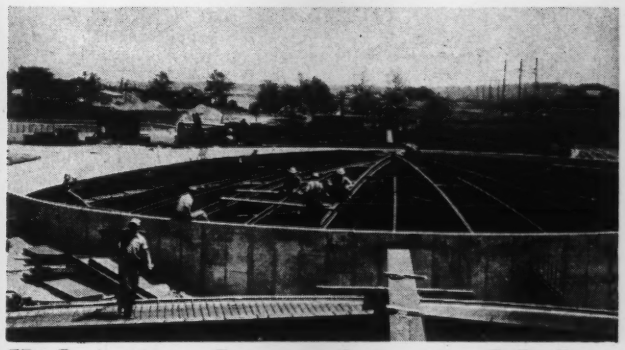
"BUILDING FOR THE NATIONS"—A candid, factual photographic record, in full color, of the highlights of the fabrication and erection of the structural steelwork for the Secretariat Building of the United Nations is now obtainable. Scenes include preparation of the site and building the foundations, fabrication of the structural members, erection of the giant column beams and sections, riveting and finally dedication. On 16-mm film, the motion picture is 35 minutes long. **United States Steel Corporation, CE-11-125, 525 William Penn Place, Pittsburgh 30, Pa.**

"SINEWS OF THE SOUTH"—A fascinating story of the largest steel producing company in the South is expertly and dramatically photographed. The film includes scenes from the ore and coal mines, quarries, conditioning plants, blast furnaces, and operations in the various finishing mills. This motion picture conveys the enormous amount of work that is done to produce a ton of pig iron, plus the tremendous investment required to manufacture numerous items of steel from nails to ocean-going vessels. Available only in the South, the film's projection time is 34 minutes. **United States Steel Corporation, CE-11-125, Birmingham Film Distribution Center, Fairfield, Ala.**

"FULL CIRCLE"—An animated 14 minute film, in color, tells the story of oil. Barren wastes, from which, for thousands of years, people have clawed a precarious living, may conceal great wealth in the form of oil held fast in the depths of the rock beneath. Diagrammatically the drill is shown probing layer after layer of rock until it finds the reservoir. The movie then depicts how crude oil is transported by pipeline from the well-head areas to refineries where it is resolved into a multiplicity of products demanded by the modern world. **British Information Services, CE-11-125, 30 Rockefeller Plaza, New York 20, N. Y.**

"ROAD BLOCK"—Since good highways are of vital concern to everyone, a new color motion picture is aimed at alerting the public to one of the nation's most critical needs. The film depicts the fact that everyone agrees that the public should have good roads—the housewife wants safe highways, the traveling salesman wants better superhighways, the farmer wants better farm-to-market needs. Who should come first is the question asked in the film. In developing the story, the movie portrays the personal interest of each type of person involved. The objections they make are answered by a series of authorities on the subject. Though such diverging interests must be considered, the 20 minute film points out that the program can only succeed through cooperative action. Only by planning and discussion can progress be made on this problem which is rapidly approaching a national emergency. **Caterpillar Tractor Co., CE-11-125, Peoria 8, Ill.**





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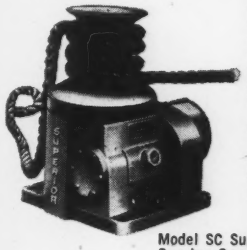

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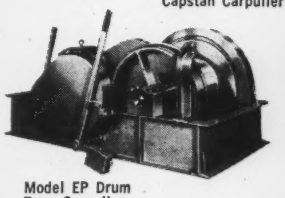
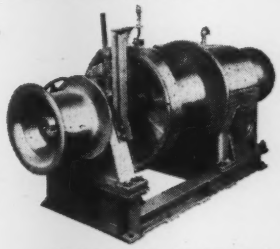


Model EP Drum Type Carpuller



30 H.P. Electric Mooring Winch

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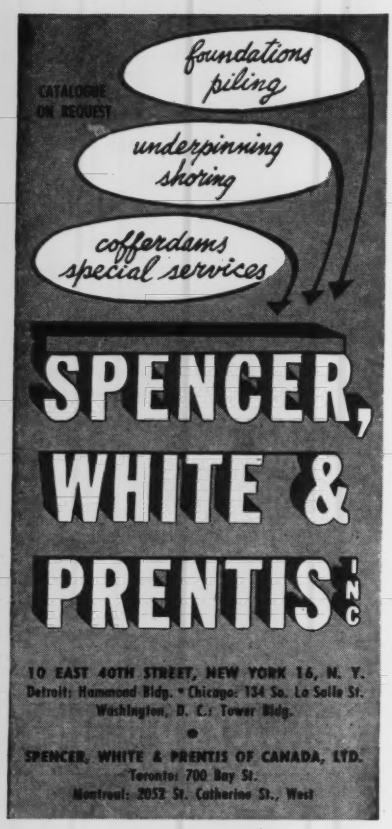
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From the MANUFACTURERS

2000 MILE PARKWAY: Congress has authorized a half million dollars for preliminary planning for the Mississippi River Parkway, extending from the source of the river to its mouth, in aid to the ten states through which it flows. A survey of possible routes has been completed and several links have been already officially approved by the individual states and the United States Bureau of Public Roads. . . **FLOATING HELIPORTS:** Dravo Corporation is undertaking the commercial manufacture of prefabricated heliports. Standard Heliports, Inc., of Minneapolis, designer of the heliport, will act in a consulting capacity for the operation. Floating platforms which can be anchored in rivers, lakes and bays will be the chief type manufactured. . .**INVITATION TO MIAMI BEACH:** The American Road Builders' Association will hold its Annual Convention and Exhibit of Highway Materials and Supplies at the Miami Beach Auditorium January 11–14. . .**DEDICATION CEREMONY:** The new Fritz Engineering Laboratory of Lehigh University was recently dedicated at Bethlehem, Pa. A civil engineering laboratory, it boasts the world's largest vertical testing machine. All facilities in this new laboratory are available to industries and other organizations for research work. . .**INDUSTRIAL PEACE:** Fluor Corporation has been presented with the Father Coogan Labor-Management Award for signal achievements in labor-management relationships throughout the year. . .**SALES GAIN:** Retail deliveries of 1955 GMC trucks rose to unprecedented heights in the five months following volume production of the new models, topping last year's figures for the corresponding period by 59.3 per cent. . .**ATOMIC ELECTRICITY:** The Atomic Power Division of Westinghouse is building the reactor for the nation's first atomic-powered electric generation station at Shippingport, Pa. When completed in 1957, it will generate electricity for the entire Pittsburgh area. The Duquene Light Company will operate the plant. . .**23 MILES OF TRENCHES:** A Cleveland Model Trencher recently completed digging drainage-irrigation trenches in the dry bed of Buena Vista Lake in the San Joaquin Valley at the rate of 18-cu yd per minute. The 23 miles of trenches are 7½ ft deep and 12 ft wide at ground surface. . .**APPOINTMENTS:** David H. Barrett and Donald Kowtko, members of ASCE, join the staff of the Esso Research and Engineering Company. . .The S. Morgan Smith Company announces the appointment of Joseph H. Boigegrain to the position of Assistant to the Sales Manager. . .Warren Coate, former Southwestern Regional Manager, has been appointed a Vice-President of the Charles Bruning Company. . .Henry W. Leland is the new Manager of Media Planning and Research at General Electric.

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795. **Elastic Instability of Flat Plates Subjected to Partial Edge Loads, by Lev Zetlin.** (EM) Buckling loads of flat rectangular plates subject to loads distributed over short parts of the edges are determined. The equations governing the buckling loads are considered and an approach to the solution is made by means of the energy method. Results of computations have been reduced to curves suitable for design purposes. These curves are given for a wide range of plate dimensions and loading widths. The theoretical results are compared with those of a number of tests.

796. **An Experimental Study of Boundary Layer Transition, by H. W. Bennett and Charles A. Lee.** (EM) Transition on a smooth flat plate in a zero pressure gradient was studied in a wind tunnel using conventional surface tube and hot wire techniques. The effect of free-stream turbulence was studied in terms of the energy concentrated at the amplified frequency.

797. **Lateral Buckling of Rolled Steel Beams, by R. A. Hechtman, J. S. Hattrup, E. F. Styer, and J. L. Tiedemann.** (EM) This investigation of the lateral buckling of rolled steel beams under transverse loading included 10-in., 12-in., and 18-in. beams simply supported or bolted by semirigid connections. Good correlation was found between the theoretical and the actual buckling strength for the more slender beams.

798. **Soil Mechanics and Work-Hardening Theories of Plasticity, by D. C. Drucker, R. E. Gibson, and D. J. Henkel.** (EM) It is suggested that soil be treated as a work-hardening material which may reach the perfectly plastic state. A good qualitative agreement with the known behavior of soils in triaxial tests is thus obtained.

799. **Discussion of Proceedings Papers 529, 670, 671, 677.** (EM)

800. **Missouri River Basin Plan in Operation, by Wendell E. Johnson.** (WW) This paper reports progress made since World War II on the water resource program undertaken in the Missouri Basin. Many projects are already in operation, and the benefits of flood control, power generation, irrigation, and navigation are being realized increasingly each year as new features of the program are added.

801. **Control of Arroyo Floods at Albuquerque, New Mexico, by Rufus H. Carter, Jr.** (WW) After thunderstorms of high intensity, flows of short duration but high peak from arroyos flood nearby valleys. This paper includes proposals for two diversion channels designed to convey flood flows around densely populated high-value lands.

802. **Upper Minneapolis Harbor Development, Minnesota, by L. G. Yoder.** (WW) The improvement of the upper Mississippi River (to provide a minimum channel depth of nine feet) includes two locks, channel dredging, removal of an existing dam, improvements to another, and construction of a new dam. The work is complicated by unfavorable geology and by the necessity for close control of water levels between the two locks. The history of the development and the principal factors influencing design are described in detail.

803. **Flood Control in the Middle Mississippi, by Walter F. Lawlor.** (WW) In the Middle Mississippi, the flood problem is of major importance because of the industrial and agricultural development of the valley. The efforts of local interests through organized levee districts, supplemented by major assistance under federal flood control policy, will provide economical and practicable protection.

804. **Stiffening Lock Gates by Prestressing Diagonals, by Carl L. Shermer.** (WW) This paper presents a method for the control of the warping or twisting of mitering-type navigation lock gates which occurs when the gates are swung through the water. The gate leaf is analyzed torsionally, and the function of the diagonal members in resisting torsional forces is explained. Expressions for torsional deflection and corresponding stresses in the diagonal members are developed. The application of theory to design and the field technique for prestressing are presented.

805. **Protection of Subsiding Waterfront Properties, by Robert R. Shoemaker.** (WW) An extensive land subsidence problem in some highly developed waterfront areas in Los Angeles County is considered, and methods of protecting the subsiding properties are outlined. The nature of the problem, individual examples of remedial measures, and some economic aspects are described.

806. **Ground Water Phenomena Related to Basin Recharge, by Paul Baumann.** (HY) The Los Angeles County Flood Control District has caused approximately 1,200,000 acre-ft of potable water to be added to the ground-water supply by percolation from basins in off-channel spreading grounds and by injection through wells. Phenomena related to these activities are described in this paper; a review of previously developed theory is made, and its practical application is sketched.

807. **Discussion of Proceedings Papers 517, 700, 740.** (PO)

808. **Discussion of Proceedings Papers 404, 462, 620, 623, 728.** (IR)

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809. Report of ASCE-ACI Joint Committee on Ultimate Strength Design. (ST) This report presents recommendations and formulas for the design of reinforced concrete structures by ultimate strength theories together with basic supporting and explanatory data. The report is confined to the design of sections; it does not deal with the evaluation of the external moments and forces that exist in structures.

810. Discussion of Proceedings Papers 499, 597, 703. (HW)

811. A General Method of Analysis of Rigid Frames, by Panagiotis D. Moliotis. (ST) In this paper a new method for computing rigid frames by successive approximations is analyzed. This method unifies the two steps of the classical method of computation so that by new factors of distribution and transmission a solution is more quickly and simply obtained.

812. Discussion of Proceedings Papers 562, 649, 651, 652, 659. (ST)

813. Discussion of Proceedings Papers 544, 558, 583, 663. (ST)

814. Shear Deflection of Wide Flange Steel Beams in the Plastic Range, by W. J. Hall and N. M. Newmark. (EM) The following topics are included in this paper: 1. The results of tests of two continuous steel I-beams having regions subjected to pure bending, bending combined with low shear, and bending combined with high shear. 2. A comparison of some of the test results with current design specifications. 3. Data for estimating the component of deflection caused by shear when regions of the beams have undergone general shear yielding. 4. Theoretical examples illustrating the effects of general shear yielding of the web on the deformation characteristics of the beams.

815. Oscillatory Gravity Waves in Flowing Water, by Turgut Sarpkaya. (EM) The main objectives of this study were to determine the conditions of stability of progressive oscillatory gravity waves in water flowing over smooth and artificially roughened surfaces and to evaluate the combined effect of various interrelated characteristics of flowing water—viscous shear, turbulent mixing shear, and nonuniform velocity distribution—on their propagation.

816. Structural Vibrations Produced by Ground Motion, by D. E. Hudson and G. W. Housner. (EM) Simultaneous measurements of transient ground motion caused by a large quarry blast and the resulting structural vibrations in a steel frame building are described. Building accelerations computed from the measured ground accelerations are compared directly with measurements made in the building. The satisfactory agreement between the computed and measured building responses indicates that the general method of replacing a complex structure by a simplified dynamic model gives results of engineering significance even for complicated transient loadings.

817. Flow into a Well by Electric and Membrane Analogy, by Chong-Hung Zee, Dean F. Peterson, and Robert O. Bock. (EM) A study of radially symmetrical, unconfined flow to a well is reported. Using dimensional considerations, the discharge of such a system is related to the permeability of the aquifer and the geometric characteristics of the influence region. The electrical analogy for hydraulic flow is combined with the membrane analogy for the free surface. The experimental results and observations of other investigators are combined to obtain empirical relationships between the flow and the geometric variables.

818. Thick Rectangular Plates on an Elastic Foundation, by Daniel Frederick. (EM) Equations and solutions for the bending of thick rectangular plates resting on an elastic foundation are presented using the theory of plates developed by E. Reissner. Various types of fixity of edges involving three boundary conditions are considered. Two simple examples are included.

819. Discussion of Proceedings Papers 692, 694, 695. (EM)

820. Physical and Chemical Control of Insects: Progress Report of the Sanitary Engineering Research Committee, Public Health Engineering Section. (SA) The effectiveness of several types of screening and of residual insecticides incorporated in surface-protective coatings is reported, based on results of field and laboratory tests.

821. The Effect of Nutrients upon the Rate of Stabilization of Spent Sulfite Liquor in Receiving Waters: Progress Report of the Sanitary Engineering Research Committee, Stream Pollution Section. (SA) The results of a research project on the effect of sulfite waste liquor on the Willamette River in Oregon are presented in summarized form, critically considered, and evaluated constructively with a view toward engineering application.

822. Discussion of Proceedings Papers 547, 685, 686, 687, 750, 779. (SA)

823. Rigid Culverts under High Overfills, by R. Robinson Rowe. (HW) Adaptation of the earth arch to relieve culverts of part of their load has promised substantial economy. This practice has been justified by satisfactory performance. The paper summarizes progressive developments in design and reports the findings of a field review, including suggestions for further development of the practice.

824. Using Consultants to Expand a Highway Program, by Rex M. Whitton. (HW) The practice of the State of Missouri in using consultants to supplement the regular highway staff is described. The practice is more costly but recommended when the state's personnel or work capacity is limited. Examples are given.

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